P R O J E C T M A N U A L

WEBER STATE UNIVERSITY

RESIDENTIAL LIFE PHASE 2

BUILDING 2

VOLUME ONE
DIVISIONS ONE - FOURTEEN

CONSTRUCTION DOCUMENTS

MHTN PROJECT NO 2010543.00
DFCM PROJECT NO 10176810

14 APRIL 2011

MHTN
ARCHITECTS

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CERTIFICATIONS PAGE

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All professional seals (stamps) to be signed and dated; Architect Licensing Act Rules R156-3a, Utah Administrative Code, paragraph 601 and Professional Engineers Licensing Act Rules R156-22, Utah Administrative Code, paragraph 601.

RESIDENTIAL LIFE BUILDING - Phase 2 Building 2
WEBER STATE UNIVERSITY

Table of Contents

CONSTRUCTION DOCUMENTS

14 April 2011

MHTN PROJECT NO 2010543.00
DFCM PROJECT NO 10176810

Division	Section Title	Pages
TAX EXEMPTION CERTIFICATE TC-721G		1

Division	Section Title	
SPECIFICATIONS GROUP		
	General Requirements Subgroup	Pages
DIVISION 01 - GENERAL REQUIREMENTS		
011000	SUMMARY	
012200	UNIT PRICES	
	ARCHITECTURAL COST BREAKDOWN	
	MECHANICAL COST BREAKDOWN	
	ELECTRICAL COST BREAKDOWN	3
012300	ALTERNATES	2
012500	SUBSTITUTION PROCEDURES	1
	SUBSTITUTION REQUEST FORM CSI Form 13.1A	1
012600	CONTRACT MODIFICATION PROCEDURES	2
012900	PAYMENT PROCEDURES	2
013100	PROJECT MANAGEMENT AND COORDINATION	4
013150	BUILDING INFORMATION MODELING	2
013200	CONSTRUCTION PROGRESS DOCUMENTATION	2
013233	PHOTOGRAPHIC DOCUMENTATION	4
013300	SUBMITTAL PROCEDURES	5
	LICENSE AND INDEMNIFICATION AGREEMENT	2
014000	QUALITY REQUIREMENTS	6
014200	REFERENCES	3
014533	STRUCTURAL TESTS AND SPECIAL INSPECTIONS	9
014620	FIRE RATED ASSEMBLIES	1
015000	TEMPORARY FACILITIES AND CONTROLS	6
015639	TEMPORARY TREE AND PLANT PROTECTION	2
		5
		3
		8
		10

016000	PRODUCT REQUIREMENTS	4
017300	EXECUTION	10
017419	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL	20
017700	CLOSEOUT PROCEDURES	5
017823	OPERATION AND MAINTENANCE DATA	10
017839	PROJECT RECORD DOCUMENTS	5
017900	DEMONSTRATION AND TRAINING	5
018113	SUSTAINABLE DESIGN REQUIREMENTS	8
	SUSTAINABLE DESIGN MATRIX	6
019113	GENERAL COMMISSIONING REQUIREMENTS	9
019125	BUILDING ENCLOSURE COMMISSIONING	8

Facility Construction Subgroup

DIVISION 2 – EXISTING CONDITIONS

024116	STRUCTURE DEMOLITION	7
024117	HAZARDOUS MATERIALS ABATEMENT	2
024119	SITE DEMOLITION	4

DIVISION 03 - CONCRETE

033000	CAST-IN-PLACE CONCRETE	20
034500	PLANT – PRECAST ARCHITECTURAL CONCRETE	12

DIVISION 04 - MASONRY

042000	UNIT MASONRY ASSEMBLIES	16
044200	DIMENSION STONE CLADDING	13

DIVISION 05 - METALS

051200	STRUCTURAL STEEL	6
052100	STEEL JOIST FRAMING	5
053100	STEEL DECKING	7
054000	COLD-FORMED METAL FRAMING	8
055000	METAL FABRICATIONS	9
055100	METAL STAIRS	8
055210	PIPE AND TUBE RAILINGS	8
055300	GRATINGS	6
057200	ORNAMENTAL HANDRAILS AND RAILINGS	8

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

061053	MISCELLANEOUS ROUGH CARPENTRY	5
061600	PANEL SHEATHING	4
064023	INTERIOR ARCHITECTURAL WOODWORK	10
066400	FIBERGLASS REINFORCED PANELING	3

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

071326	SELF-ADHERING SHEET WATERPROOFING	6
071413	HOT FLUID APPLIED WATERPROOFING	11
071900	WATER REPELLANTS	4
072100	THERMAL INSULATION	7
072726	FLUID APPLIED MEMBRANE AIR BARRIERS	9
074123	METAL SOFFIT PANELS	7

074243	COMPOSITE METAL WALL SYSTEMS	9
075419	POLYVINYL CHLORIDE MEMBRANE ROOFING	12
	DFCM 30 YEAR WARRANTY FORM	3
076200	SHEET METAL FLASHING AND TRIM	7
077200	ROOF ACCESSORIES	5
078100	APPLIED FIREPROOFING	9
078413	THROUGH-PENETRATION FIRESTOP SYSTEMS	8
079200	JOINT SEALANTS	11
079500	EXPANSION CONTROL	5

DIVISION 08 - OPENINGS

081113	STEEL DOORS AND FRAMES	7
081416	FLUSH WOOD DOORS	6
083113	ACCESS DOORS	4
083326	OVERHEAD COILING GRILLES	7
084113	ALUMINUM ENTRANCES AND STOREFRONTS	10
084126	ALL-GLASS INTERIOR GLAZING	5
084413	GLAZED ALUMINUM CURTAIN WALLS	11
085113	ALUMINUM WINDOWS	11
087100	DOOR HARDWARE	24
087101	DOOR HARDWARE SCHEDULE	13
088000	GLASS AND GLAZING	9

DIVISION 09 - FINISHES

092115	GYPSUM BOARD ASSEMBLIES	14
092117	GYPSUM BOARD SHAFT-WALL ASSEMBLIES	5
092713	GLASS-REINFORCED GYPSOM FABRICATIONS	6
093000	TILING	10
095113	ACOUSTICAL PANEL CEILINGS	9
095134	ACOUSTICAL METAL PAN CEILINGS	9
096511	RESILIENT TERRAZZO TILE	6
096513	RESILIENT BASE AND ACCESSORIES	6
096516 13	LINOLEUM FLOORING	6
096516	SHEET VINYL SAFETY FLOOR COVERINGS	5
096566	RESILIENT ATHLETIC FLOORING	5
096813	TILE CARPETING	5
099120	PAINTING	13

DIVISION 10 - SPECIALTIES

101400	INTERIOR SIGNAGE	3
	SIGN ORDER	10
102116	SHOWER COMPARTMENTS	3
102600	IMPACT RESISTANT WALL PROTECTION	5
102800	TOILET BATH AND LAUNDRY ACCESSORIES	5
104413	FIRE-PROTECTION SPECIALTIES	5
105500	POSTAL SPECIALTIES	3
107315	EXTERIOR SUN CONTROL DEVICES	4

DIVISION 11 – EQUIPMENT

116823	SAND VOLLEYBALL COURT	4

DIVISION 12 - FURNISHINGS

122413	ROLLER SHADES	5
124813	FLOOR MATS	3
129300	SITE FURNISHINGS	5

DIVISION 14 - CONVEYING EQUIPMENT

142400	HYDRAULIC ELEVATOR	11

VOLUME TWO

Facility Services Subgroup

DIVISION 21 – FIRE SUPPRESSION

211000	FIRE PROTECTION	20

DIVISION 22 – PLUMBING

221113	FACILITY WATER DISTRIBUTION PIPING	10
221313	FACILITY SANITARY SEWERS	12
221410	PLUMBING PIPING	7
221411	DISINFECTING WATER SUPPLY SYSTEM	5
221430	PLUMBING SPECIALITES	14
224440	PLUMBING FIXTURES	10
224450	PLUMBING EQUIPMENT	7
224460	SPECIAL PLUMBING EQUIPMENT SYSTEMS	4

DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING

230500	BASIC MECHANICAL REQUIREMENTS	18
230529	BASIC MECHANICAL MATERIALS AND METHODS	30
230540	MECHANICAL SOUND AND VIBRATION CONTROL	22
230548	MECHANICAL SEISMIC CONTROL	6
230593	TESTING, ADJUSTING AND BALANCING	6
230700	MECHANICAL INSULATION	10
230800	COMMISSIONING OF HVAC	11
230810	VARIABLE FREQUENCY DRIVE	7
230900	ELECTRONIC CONTROLS	37
231123	NATURAL GAS SYSTEM	8
232113	HVAC PIPING AND SPECIALTIES	18
232123	HVAC PUMPS	5
232500	HVAC WATER TREATMENT	8
233300	DUCTWORK AND ACCESSORIES	17
233400	AIR HANDLING FANS	5
233713	AIR INLETS AND OUTLETS	4
234100	AIR CLEANING	3
235100	BREECHINGS, CHIMNEYS, STACKS AND FLUES	4
235200	BOILERS	5
235550	SOLAR ENERGY SYSTEMS	13
235700	HEAT TRANSFER	4
236400	REFRIGERATION	9
237400	AIR HANDLING SYSTEMS ON ROOF	8
238146	HEAT PUMPS	7

DIVISION 26 ELECTRICAL -

260500	COMMON WORK RESULTS FOR ELECTRICAL	9
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES	7
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS	7
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	5
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS	12
260536	CABLE TRAYS FOR ELECTRICAL SYSTEMS	5
260543	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS	14
260548	VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS	8
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS	9
260573	OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY	7
260574	ELECTRICAL TESTING	2
260800	ELECTRICAL SYSTEMS COMMISSIONING	8
260923	LIGHTING CONTROL DEVICES	5
262413	SWITCHBOARDS	10
262416	PANELBOARDS	9
262713	ELECTRICITY METERING	5
262726	WIRING DEVICES	7
262813	FUSES	3
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS	8
263600	TRANSFER SWITCHES	6
264313	SURGE PROTECTIVE DEVICES (SPDs)	7
265100	INTERIOR LIGHTING	8
265600	EXTERIOR LIGHTING	8

DIVISION 27 - ELECTRICAL SAFETY AND SECURITY

270528	PATHWAYS FOR COMMUNICATIONS SYSTEMS	6

DIVISION 28 - ELECTRICAL SAFETY AND SECURITY

283111	DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM	22

Site and Infrastructure Subgroup

DIVISION 31 - EARTHWORK

310700	GENERAL SITE CONSTRUCTION REQUIREMENTS	4
311000	SITE CLEARING	6
312000	EARTH MOVING	14
312319	DEWATERING	6
315000	EXCAVATION SUPPORT AND PROTECTION	4

DIVISION 32 - EXTERIOR IMPROVEMENTS

321216	ASPHALT PAVING	10
321313	CONCRETE PAVING	16
321373	CONCRETE PAVING JOINT SEALANTS	8
321400	UNIT PAVAERS	5
321443	POROUS UNIT PAVING	5
322000	SITE SIGNAGE	4
323119	ORNAMENTAL METAL FENCES AND GATES	7
323230	BOULDERS	3
328400	IRRIGATION SYSTEMS	21

328402	DRIP IRRIGATION SYSTEMS	12
329200	LAWNS AND GRASSES	9
329300	LANDSCAPE PLANTING	15

DIVISION 33 - UTILITIES

330500	COMMON WORK RESULTS FOR UTILITIES	12
334110	STORM UTILITY DRAINAGE PIPING	18
334600	SUBDRAINAGE	10

APPENDIX

GSH Geotechnical Report December 15, 2010 46

Utah State Tax Commission

Exemption Certificate for Governments & Schools

(Sales, Use, Tourism and Motor Vehicle Rental Tax)

TC-721G
Rev. 12/08

Name of institution claiming exemption (purchaser)			Telephone Number	
Street Address		City	State	ZIP Code
Authorized Signature	Name (please print)		Title	
Name of Seller or Supplier:			Date	

The person signing this certificate MUST check the applicable box showing the basis for which the exemption is being claimed. Questions should be directed (preferably in writing) to Taxpayer Services, Utah State Tax Commission, 210 N 1950 W, Salt Lake City, UT 84134. Telephone (801) 297-2200, or toll free 1-800-662-4335.

DO NOT SEND THIS CERTIFICATE TO THE TAX COMMISSION
Keep it with your records in case of an audit.

☐ **UNITED STATES GOVERNMENT OR NATIVE AMERICAN TRIBE**
I certify the tangible personal property or services purchased are to be paid directly with funds from the entity noted on this form and will be used in the exercise of essential governmental or tribal functions. NOTE: Includes sales of tangible personal property to federally chartered credit unions. "Directly" does not include per diem, entity advances or similar indirect payments.

☐ **CONSTRUCTION MATERIALS PURCHASED FOR SCHOOLS OR PUBLIC TRANSIT DISTRICTS**
I certify the construction materials purchased are on behalf of a public elementary or secondary school, or public transit district. I further certify the purchased construction materials will be installed or converted into real property owned by the school or public transit district.
Name of school or public transit district: _____
Name of project: _____

☐ **UTAH STATE AND LOCAL GOVERNMENTS AND PUBLIC ELEMENTARY AND SECONDARY SCHOOLS**
Sales Tax License No. _____
I certify the tangible personal property or services purchased are to be paid directly with funds from the entity noted on this form and will be used in the exercise of that entity's essential functions. For construction materials, if the purchaser is a Utah state or local government, these construction materials will be installed or converted into real property by employees of this government entity. "Directly" does not include per diem, entity advances, or similar indirect payments. **CAUTION:** This exemption does not apply to government or educational entities of other states.

IMPORTANT: To protect your privacy, use the "Clear form" button when you are finished. Clear form

To be valid this certificate must be filled in completely, including a check mark in the proper box.

A sales tax license number is required only where indicated.

Please sign, date and, if applicable, include your license or exemption number.

NOTE TO SELLER: Keep this certificate on file since it must be available for audit review.

NOTE TO PURCHASER: Keep a copy of this certificate for your records. You must notify the seller of cancellation, modification, or limitation of the exemption you have claimed.

If you need an accommodation under the Americans with Disabilities Act, contact the Tax Commission at (801) 297-3811 or TDD (801) 297-2020. Please allow three working days for a response.

TECHNICAL SPECIFICATIONS

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Residential Life Phase 2 Building 2 , Weber State University.

B. The Project will be constructed in accordance with LEED prerequisites and credits needed for Project to obtain at a minimum a LEED Silver certification based on LEED-NC, Version 3.0.

The Contractor is responsible for compliance with all applicable codes, DFCM Construction standards and Weber State Construction Standards for Architects, Engineers and Contractors in carrying out the Work.

The new construction is a three level, above grade structure, housing 55 Suite units, 2 Resident Manager apartments, lounge and gathering spaces, kitchenette and Food Service spaces, storage and building service areas. The project scope includes parking, landscaping and paved walkways.

Demolition of the existing Wasatch Hall, will be included as work of this contract. Abatement will be completed by the Owner.

The location of the project requires extensive protection of the existing trees and landscaping adjacent to the area of work. Protection zone fencing will be required along the drip line of trees.

An interior mock-up of a sample suite will be required to be completed by the end of February 2012, to serve as a mockup for quality assurance and as an example of a sample suite provided by construction of this project, as a model for prospective students. Access across site and into the structure under construction will be required to permit safe access. Construction is included as part of the work.

Building Pad certification is required for the work certifying that the rough building pad has been graded to specified tolerances, building lines, foundations and parking areas are located within specified tolerances and in conformance with the Construction Documents.

C. This project will require construction of an enclosed full-scale mock-up of exterior wall, exterior walls at corners and roof conditions to permit preliminary testing of the building envelope as exterior enclosure materials are added. Results of this testing shall affect compliance with the Exterior Envelope Commissioning required to comply with the Owner's contract requirements. Contractor will provide adequate structural support for the mock-up to remain in place during the course of construction. Construction of mock-up is included as part of the Work.

D. Architect Identification: The Contract Documents were prepared for the Project by MHTN Architects, 420 East South Temple, Salt Lake City, Utah 84111

1.3 CONSTRUCTION SCHEDULE

A. Contractors shall provide adequate personnel and extend workdays and work weeks to comply with the schedule requirements of this project.

1.4 CONTRACT COORDINATION

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1.5 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to immediate areas of the work of this contract as shown on Drawings.
2. Owner Occupancy: Allow for Owner occupancy and access to existing adjacent facilities
3. Driveways, Walkways and Entrances: Keep driveways, walkways (as directed by Owner) and entrances serving premises and adjacent buildings clear and available to Owner, Owner's employees, adjacent building occupants and emergency vehicles at all times. Do not use these areas for parking or storage of materials unless alternative plans for access are submitted and approved by the Architect and Owner prior to the start of work.

B. Maintain existing adjacent buildings and structures in a weather tight condition throughout construction period. Repair damage caused by construction operations. Protect adjacent buildings and structures during construction period.

C. Provide temporary fencing and barricades to isolate the work area from the public in adjacent areas. Generally , fencing is to follow the construction Limit Lines.

1.6 OCCUPANCY REQUIREMENTS

A Partial Owner Occupancy: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
3. Before partial Owner occupancy, Fire suppression, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of building.

1.7 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the Masterformat 2004 Edition modified into a 33-division format and CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

B. Related Sections include the following:

1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Division 1 Section "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

A. Unit price is **an amount proposed by bidders, stated on the Bid Form, as** a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, overhead, and profit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A list of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

A. **Unit Price No. 1:** unit price per ton to remove soft spots as directed by the architect or soils engineer. The Unit price per ton includes all excavation, trucking, hauling, dumping fees, etc to remove soft spots. Weight tickets will be required for all material removed under this unit price to receive payment.

B. **Unit Price No. 2**: unit price per ton to replace material removed above with course gravels, cobbles, and large gravels as directed by the Architect or Soils Engineer. Weight tickets will be required for all material imported under this unit price to receive payment.

C. **Unit Price 3** : Mechanical Heat Pumps

D. **Unit Price 4** : Electrical: As indicated on attached forms

END OF SECTION 012200

ARCHITECTURAL COST BREAKDOWN FORM

The General Contract bid will be tabulated using the Column "Base Bid" total along with all other work. (All other items not specifically listed on this form are to be bid as specified, as listed on the Drawings, or as approved in the Addendum to the contract documents.) Prices shall be as quoted to the Contractor by the vendor, exclude sales tax.

The General Contractor, will provide this form complete, to the Owner with the Bid Form. Prices shall be verified by a copy of the quotation upon request.

Vendors not specifically pre-listed under alternate Columns A, B, C, D, E or "F" on this form may be submitted as a substitute by the Contractor for consideration by the Owner following procedures noted in the specification. If a column does not have a vendor pre-listed and a substitute has been pre-approved, the Contractor may indicate the vendor providing the price in the "other" column. Items not specifically listed on this form, in the Specification, on the Drawings or as approved in the Addendum to the contract documents, cannot be listed on the Architectural Bid Breakdown.

The Owner is obligated to use items in Column "Base Bid". The Owner may elect to pick and choose from among alternative offerings in Columns A, B, C, D, E and "F" via change order. The contract shall be adjusted without markup for any price differential between the price listed in Column "Base Bid" and that listed in any selected alternative column. The Owner reserves the right to accept or reject any of the items anytime within ninety (90) days after signing a contract.

Item	Specification Section	Base Bid	A	B	C	D	E	F
	087100 Door Locksets at Bedrooms/Suite Entry	$	Corbin Russwin $	Schlage $	Sargent $	$	$	$

MECHANICAL COST BREAKDOWN FORM

The General Contract bid will be tabulated using the Column "Base Bid" total along with all other Mechanical work. (All other Mechanical items not specifically listed on this form are to be bid as specified, as listed on the Drawings, or as approved in the Addendum to the contract documents.) Prices shall be as quoted to the Contractor by the vendor, exclude sales tax.

The General Contractor, will provide this form complete, to the Owner with the Bid Form. Prices shall be verified by a copy of the quotation upon request.

Vendors not specifically pre-listed under alternate Columns A, B, C, D, E or "F" on this form may be submitted as a substitute by the Contractor for consideration by the Owner following procedures noted in the specification. If a column does not have a vendor pre-listed and a substitute has been pre-approved, the Mechanical Contractor may indicate the vendor providing the price in the "other" column. Mechanical items not specifically listed on this form, in the Specification, on the Drawings or as approved in the Addendum to the contract documents, cannot be listed on the Mechanical Bid Breakdown.

The Owner is obligated to use items in Column "Base Bid". The Owner may elect to pick and choose from among alternative offerings in Columns A, B, C, D, E and "F" via change order. The contract shall be adjusted without markup for any price differential between the price listed in Column "Base Bid" and that listed in any selected alternative column. The Owner reserves the right to accept or reject any of the Equipment or System items anytime within ninety (90) days after signing a contract.

Item	Specification Section	Base Bid	A	B	C	D	E	F
	230900 Electronic Controls	$	Johnson Controls $	Atkinson Electronics $	Utah Yamas $	Delta Controls $	Trane Controls $	Harris Controls $
	238146 Heat Pumps	$	Trane $	Climate Master $	Carrier $	First Co. $	Whalen Co. $	Waterfurnace $

ELECTRICAL COST BREAKDOWN FORM

The General Contract bid will be tabulated using the Column "Base Bid" total along with all other electrical work. (All other electrical items not specifically listed on this form are to be bid as specified, as listed on the Drawings, or as approved in the Addendum to the contract documents.) Prices shall be as quoted to the Contractor by the vendor, exclude sales tax.

The General Contractor, will provide this form complete, to the Owner with the Bid Form. Prices shall be verified by a copy of the quotation upon request.

Vendors not specifically pre-listed under alternate Columns A, B, C, D or "E" on this form may be submitted as a substitute by the Contractor for consideration by the Owner following procedures noted in the specification. If a column does not have a vendor pre-listed and a substitute has been pre-approved, the Electrical Contractor may indicate the vendor providing the price in the "other" column. Electrical items not specifically listed on this form, in the Specification, on the Drawings or as approved in the Addendum to the contract documents, cannot be listed on the Electrical Bid Breakdown.

The Owner is obligated to use items in Column "Base Bid". The Owner may elect to pick and choose from among alternative offerings in Columns A, B, C, D and "E" via change order. The contract shall be adjusted without markup for any price differential between the price listed in Column "Base Bid" and that listed in any selected alternative column. The Owner reserves the right to accept or reject any of the Equipment or System items anytime within ninety (90) days after signing a contract.

Item	Specification Section	Base Bid	A	B	C	D	E
	260536 Cable Tray	$	Mono Systems $	Cooper B-Line $	MP Huskey $	PW Industries $	
	260923 Lighting Control Devices	Watt Stopper $					
	260923 Lighting Control Relay Panel	Watt Stopper $					
	264313 Surge Protective Devices (SPD's)	$	Current Technology $	Liebert Corp $	United Power $	Intermatic $	Square-D $
	262816 Enclosed Switches and Circuit Breakers	$	Cutler-Hammer $	Siemens $	GE $	Square-D $	

ELECTRICAL COST BREAKDOWN FORM

	262413 Switchboards	$	Cutler-Hammer $	Siemens $	GE $	Square-D $	
	262416 Panelboards	$	Cutler-Hammer $	Siemens $	GE $	Square-D $	
	265100 Interior Lighting Package T-1 & T-15	$	JRC $	Quantum Ltg. $			
	265100 Interior Lighting Package T-2 & T-13	$	JRC $	Quantum Ltg. $	Light Source $	Layton Sales $	
	265100 Interior Lighting Package T-3, T-4, T-5, T-7, T-8, T-11, T-12	$	JRC $	Quantum Ltg. $	Light Source $	Layton Sales $	
	265100 Interior Lighting Package T-9	$	JRC $	Quantum Ltg. $	Light Source $	Layton Sales $	
	265100 Interior Lighting Package T-10	$	JRC $	Quantum Ltg. $	Light Source $	Layton Sales $	Steven Sales $
	265100 Interior Lighting Package T-16	$	JRC $				
	265100 Interior Lighting Package Ex-1 & ex-2	$	JRC $	Quantum Ltg. $	Light Source $	Layton Sales $	Steven Sales $
	Emergency Call Stations	Code Blue $					

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost for each alternate is the net addition to the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Revise Storage 116 to Suite 116.

B. Alternate No. 2: Add Cabinets near shower rooms

C. Alternate No. 3: Overlay paving in East Parking Lot.

D. Alternate No. 4 Add solar water collector panels and associated support beams and pumps

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Sections:

1. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
2. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific

features and requirements indicated. Indicate deviations, if any, from the Work specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

   a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
   b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

   a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
   b. Substitution request is fully documented and properly submitted.
   c. Requested substitution will not adversely affect Contractor's construction schedule.
   d. Requested substitution has received necessary approvals of authorities having jurisdiction.
   e. Requested substitution is compatible with other portions of the Work.
   f. Requested substitution has been coordinated with other portions of the Work.
   g. Requested substitution provides specified warranty.
   h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

   a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
   b. Requested substitution does not require extensive revisions to the Contract Documents.
   c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
   d. Substitution request is fully documented and properly submitted.
   e. Requested substitution will not adversely affect Contractor's construction schedule.
   f. Requested substitution has received necessary approvals of authorities having jurisdiction.
   g. Requested substitution is compatible with other portions of the Work.
   h. Requested substitution has been coordinated with other portions of the Work.
   i. Requested substitution provides specified warranty.
   j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

Advancement of Construction Technology

SUBSTITUTION REQUEST

(After the Bidding Phase)

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

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SUBSTITUTION REQUEST
(Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

A/E= s REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01330.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ _____

_____

_____

_____

_____

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue a field order authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710**, "**Architect's Supplemental Instructions**."**

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within **7 days** after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

   c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use DFCM form for Proposal Requests.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, the General Contractor will issue a Proposed Change Order for signatures of Owner, Architect and Contractor.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on DFCM standard form. Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used).

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:

1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

   a. Application for Payment forms with Continuation Sheets.
   b. Submittals Schedule.

2. Submit the Schedule of Values to Architect at earliest possible date but no later than **seven** days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:

   a. Project name and location.
   b. Name of Architect.
   c. DFCM and Architect's project number.
   d. DFCM contract number
   e. Contractor's name and address.
   f. Date of submittal.

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value.

      1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

   a. Differentiate between items stored on-site and items stored off-site. If stored off-site, include evidence of insurance or bonded warehousing.

6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

7. Allowances (if required): Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use **AIA Document G702 and AIA Document G703 Continuation Sheets** or Owner's required forms as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit 2 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Delays: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.

   a. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Products list.
5. Schedule of unit prices (if any)
6. Submittals Schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. Copies of building permits.
9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
10. Initial progress report.
11. Report of preconstruction conference.
12. Certificates of insurance and insurance policies.
13. Performance and payment bonds.
14. Data needed to acquire Owner's insurance.
15. Initial settlement survey and damage report if required.

H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used) –

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures.
2. Conservation.
3. Coordination Drawings.
4. Administrative and supervisory personnel.
5. Project meetings.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Summary" for a description of the Work and responsibility for coordination activities not in this Section.
2. Division 1 Section "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
3. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
4. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

A. Coordination: Contractor shall coordinate its construction operations with those of other contractors in separate phases where required, and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations of other contractors under this contract or others, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. LEED progress reports and monthly documentation

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Indicate relationship of components shown on separate Shop Drawings.

2. Above Ceiling BIM model, prepared by the Contractor showing all services above ceiling

3. Indicate required installation sequences.
4. Refer to Division 26 Section "Basic Electrical Materials and Methods" for specific Coordination Drawing requirements for electrical installations.

B. Staff Names. Within 5 days of starting construction operations, submit a list of the principal staff assignments, including superintendent and other personnel in attendance at Project site. List addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with sub-contractors.

2. Include the LEED-AP responsible for LEED submittals, coordination, procedures, documentation, etc.

1.6 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, a minimum of 1 week in advance of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: The General Contractor will record significant discussions and agreements achieved and distribute the meeting minutes to everyone concerned, including Owner and Architect, within 2 days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than **15** days after execution of the Agreement unless otherwise directed by Owner. Hold the conference at Project site. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Tentative construction schedule.
b. Phasing.
c. Critical work sequencing.
d. Designation of responsible personnel.
e. Procedures for processing field decisions and Change Orders.
f. Procedures for processing Applications for Payment.
g. Distribution of the Contract Documents.
h. Submittal procedures.
i. Preparation of Record Documents.
j. Use of the premises.
k. Responsibility for temporary facilities and controls.
l. Parking availability.
m. Office, work, and storage areas.
n. Equipment deliveries and priorities.
o. First aid.
p. Security.
q. Site Upkeep.
r. Working hours.
s. LEED requirements

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before construction activities that requires coordination with other construction as a part of weekly progress meetings.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and in-

stallations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

   a. Contract Documents.
   b. Options.
   c. Related Change Orders.
   d. Purchases.
   e. Deliveries.
   f. Submittals.
   g. Review of mockups.
   h. Possible conflicts.
   i. Compatibility problems.
   j. Time schedules.
   k. Weather limitations.
   l. Manufacturer's written recommendations.
   m. Warranty requirements.
   n. Compatibility of materials.
   o. Acceptability of substrates.
   p. Temporary facilities and controls.
   q. Space and access limitations.
   r. Regulations of authorities having jurisdiction.
   s. Testing and inspecting requirements.
   t. Required performance results.
   u. Protection of construction and personnel.
   v. LEED requirements and Progress reports

3. Record significant conference discussions, agreements, and disagreements.

4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress and coordination meetings at intervals as directed by the Owner. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner and Architect, each subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Change Orders.
14) Documentation of information for payment requests.
15) LEED progress

3. Reporting: The General Contractor will prepare meeting minutes and distribute to each party present and to parties who should have been present.

a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013150- BUILDING INFORMATION MODELING (BIM) COORDINATION AND SUBMITTALS

1.1 GENERAL

A. Coordination of Architectural building components and structural systems with the Plumbing, Fire Protection Sprinkler System, HVAC, Sheetmetal and Piping and Electrical Work, (including lights, cable trays and clearances) under the supervision of the General Contractor.

1. Creation and ongoing maintenance of the 3-dimensional electronic building model, including coordination of all listed building components, including updates during construction process.
2. Verification that all bracing, supplemental supports, ties to structural framing, and other system supports are fully coordinated with locations of all building components and are illustrated in all locations in the 3-dimensional building model.
3. The Architectural BIM will be made available to the General Contractor for use in creating the construction BIM. Note that the Architectural BIM was not created to be used by a General Contractor and will require modification. General Contractor shall first perform clash detection, using Navisworks and provide to the Architect.

B. Each individual Contractor shall maintain Building Information Modeling (BIM) contract documents and shop drawings for their division of work, as indicated in this specification section.

1. Subcontractors shall provide BIM modeling either through their own in-house drafting capabilities or through an outside source. All costs related to development and maintenance of the BIM modeling required by the Work of an individual contractor shall be the responsibility of that contractor.

C. All costs associated with development and maintenance of the Building Information Model (BIM), coordination of the components electronically and in the field, and costs associated with corrections necessary to properly install and connect components due to failure to fully investigate their relationship to one another and to the building as a whole shall be the responsibility of the Contractor.

D. All components, systems, equipment, etc. shown in the Construction BIM must include the submitted and approved items. Include required service/access spaces. The built project shall conform to these coordination drawings.

1.2 COORDINATION REQUIREMENTS

A. Include, at a minimum, the following:

1. Ceiling Systems:
2. HVAC sheetmetal and equipment, including insulation
3. HVAC Piping and Insulation
4. Plumbing and Insulation
5. Fire Protection Sprinkler Piping and Heads
6. Electrical, Lighting and Cable Trays (with 8” clearance above)

1.3 COORDINATION DRAWING PROCEDURE

A. Architectural and Engineering component Contractors: General Contractor shall direct the completion of the appropriate layouts by the component contractors prior to any other coordination work

B. General Contractor:

1. Shall overlay the BIM models and review for conflict. All conflicts shall be flagged and resolved in the coordination meetings.

1.4 COORDINATION AND DRAWING AND MODEL SUBMITTAL

A. For each coordination drawing and BIM model, each Contractor shall submit their layout to the architect for information only. These shop drawings shall be a composite drawing consisting of the Contractors' layout superimposed on the architectural and structural background model. The architectural and structural background model components shall be screened 30% for clarity. Submit after the initial layout is complete. Upon request, submit all pdf copies.

1.5 COORDINATION DRAWINGS SIGN-OFF

A. When all of the Contractors are satisfied that coordination drawing conflicts have been resolved, each contractor will sign off on the coordination drawings. The Contractors signature will signify that the Contractor has reviewed each trades' coordination drawings and will also signify the Contractors intention to complete installation as indicated on coordination drawings. Installation conflicts will be resolved as dictated by these.

1.6 MAINTAIN COORDINATION DRAWING

A. The Contractor and Subcontractors shall maintain the digital BIM coordination documents to reflect the as-built conditions, including all changes issued to the project. The General Contractor shall provide the fully coordinated and up-to-date BIM coordination documents to the Owner and Architect for their records at the completion of the project, as part of the close-out documents.

END OF SECTION 013150

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Contractor's Construction Schedule.
   2. Submittals Schedule.
   3. Daily construction reports.
   4. Field condition reports.
   5. LEED documentation
   6. Special reports.

B. Related Sections include the following:
   1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
   2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
   3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
   4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.
   5. Division 1 Section "Closeout Procedures" for submitting Project Record Documents at Project closeout.
   6. Division 1 Section “Sustainable Design Requirements” for achieving LEED status for the project.

1.3 SUBMITTALS

A. Contractor's Construction Schedule: Submit **two** opaque copies of initial schedule, large enough to show entire schedule for entire construction period. Submit prior to or at the same time as the first Application for Payment.

B. Daily Construction Reports: Submit one copy at **weekly** intervals.

C. Field Condition Reports: Submit one copy at time of discovery of differing conditions.

D. LEED Progress reports: Submit one copy each month

E. Special Reports: Submit one copy at time of unusual event.

1.4 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
   1. Discuss constraints, including **phasing and storage areas**.
   2. Review time required for review of submittals and resubmittals.
   3. Review requirements for tests and inspections by independent testing and inspecting agencies, If required
   4. Review time required for completion and startup procedures.
   5. Review and finalize list of construction activities to be included in schedule.
   6. Review submittal requirements and procedures.
   7. Review procedures for updating schedule.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

   1. Secure time commitments for performing critical elements of the Work including delivery of equipment from parties involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Reference Division 1 Section 13300 “Submittal Procedures” for assembly and timeline related to submission of submittals.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for **commencement of the Work or the Notice to Proceed** to date of **Substantial Completion**.

C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

   1. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 30 days, as separate activities in schedule.

Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

2. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
3. Startup and Testing Time: Include days for startup and testing as required by the Electrical Consultant.
4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
5. Commissioning: Indicate time for systems commissioning as specified in Division 15 Sections.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of the following items on the schedule:

   a. Coordination with existing construction.
   b. Uninterruptible services.
   c. Use of premises restrictions including coordination with the Owner to restrict dust and noise.
   d. Provisions for future construction.
   e. Environmental control.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

   a. Subcontract awards, if any.
   b. Submittals.
   c. Purchases.
   d. Fabrication.
   e. Sample testing.
   f. Deliveries.
   g. Installation.
   h. Tests and inspections.
   i. Adjusting.
   j. Startup and placement into final use and operation.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, Percentage completion mile stones and Final Completion.

F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis to demonstrate the effect of the proposed change on the overall project schedule.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. CPM Schedule: Prepare Contractor's Construction Schedule using a CPM network analysis diagram.

1. Develop network diagram to submit with the Response to the Request for Proposal.

2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
3. Use "one workday" as the unit of time.

C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

   a. Preparation and processing of submittals.
   b. Purchase of materials.
   c. Delivery.
   d. Fabrication.
   e. Installation.

2. Processing: Process data to produce output data or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
3. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

   a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

D. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the Schedule of Values).

E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

F. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.

2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.

    a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    b. Submit value summary printouts **one week** before each regularly scheduled progress meeting.

2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site(s), if any.
2. List of separate contractors at Project site where applicable
3. Approximate count of personnel at Project site.
4. High and low temperatures and general weather conditions.
5. Accidents.
6. Meetings and significant decisions.
7. Unusual events (refer to special reports).
8. Stoppages, delays, shortages, and losses.
9. Emergency procedures.
10. Orders and requests of authorities having jurisdiction.
11. Change Orders received and implemented.
12. Construction Change Directives received.
13. Services connected and disconnected.
14. Equipment or system tests and startups.
15. Partial Completions.
16. Substantial Completions.

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one day before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, sub-contractors, testing and inspecting agencies, if applicable and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final Completion construction photographs.

B. Related Sections include the following:
1. Division 01 Section "Submittal Procedures" for submitting photographic documentation.
2. Division 01 Section "Closeout Procedures" for submitting **digital media** as Project Record Documents at Project closeout.
3. Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
4. Division 01 Section “Sustainable Design Requirements” for photographic documentation.
5. Division 02 Section "Structure Demolition" for photographic documentation before building demolition operations commence.

1.3 SUBMITTALS

A. Qualification Data: For photographer.

B. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each **photograph**. Indicate elevation or story of construction. Include same label information as corresponding **set of photographs**.

C. Construction Photographs: Submit **two** prints of each photographic view within **seven** days of taking photographs.

1. Format: 8-by-10-inch (203-by-254-mm) smooth-surface matte prints on single-weight commercial-grade photographic paper, **enclosed back to back in clear plastic sleeves that are** punched for standard 3-ring binder.
2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:

a. Name of Project.
b. Name and address of photographer.
c. Name of Architects **and Construction Manager**.
d. Name of Contractor.
e. Date photograph was taken if not date stamped by camera.

f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
g. Unique sequential identifier.

3. Digital Images: Submit a complete set of digital image electronic files **with each submittal of prints** on CD-ROM. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

1.4 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.5 COORDINATION

A. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities, including temporary lighting required to produce clear, well-lit photographs without obscuring shadows.

1.6 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in uncompressed TIFF or JPEG format, produced by a digital camera with minimum sensor size of 4.0 megapixels, and at an image resolution of not less than **1024 by 768** pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in filename for each image.

2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architects **and Construction Manager**.

C. Preconstruction Photographs: Before **commencement of excavation**, take **digital** photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by **Architect and Construction Manager**.

1. Flag **excavation areas** before taking construction photographs.
2. Take a minimum of **eight** photographs to show existing conditions adjacent to property before starting the Work.
3. Take a minimum of **eight** photographs of existing buildings that are affected by future phases and either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Periodic Construction Photographs: Take **12 digital** photographs **monthly, coinciding** with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. **Architect or Construction Manager**-Directed Construction Photographs: From time to time, **Architect** or **Construction Manager** will instruct photographer about number and frequency of **digital** photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.

F. Final Completion Construction Photographs: Take **eight** color photographs after date of Substantial Completion for each phase for submission as Project Record Documents. **Architect** will direct photographer for desired vantage points.

1. Do not include date stamp.

G. Additional Photographs: Architect may issue requests for additional photographs, in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:

   a. Special events planned at Project site.
   b. Immediate follow-up when on-site events result in construction damage or losses.
   c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
   d. Substantial Completion of a major phase or component of the Work.
   e. Extra record photographs at time of final acceptance.
   f. Owner's request for special publicity photographs.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements and Submittal Schedule for submitting Shop Drawings and Product Data in electronic format, Samples, and other miscellaneous submittals in electronic format.

B. Liquidated Damages will be in effect for submittals received beyond the specified time frame for the initial submittal and any required re-submittal noted on the initial review by the Architect. Billable costs for the Architects staff to correct inadequate submittals by sub-contractors will be deducted from contract amounts in accordance with provisions of the Contract.

C. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting Applications for Payment.
2. Division 1 Section "Project Management and Coordination" for submitting Coordination Drawings.
3. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule
4. Division 1 Section "Quality Requirements" for submitting test and inspection reports and Delegated-Design Submittals.
5. Division 1 Section "Closeout Procedures" for submitting warranties Project Record Documents and operation and maintenance manuals.
6. Division 01 Section “Sustainable Design Requirements” for related submittals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect's responsive action.

B. Informational Submittals: Written information that does not require Architect's approval. Submittals may be rejected for not complying with requirements.

C. Deferred Submittals: Written information that requires design or preparation by consultants to the Contractor, not available at time of Bid.

1.4 SUBMITTAL SCHEDULE

A. Submittals Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule and within times specified herein. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
2. Initial Submittal: Include critical submittals required as soon as possible following commencement of the work. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

B. Submit schedule in PDF format in a timely manner following Notice to Proceed with sufficient time allowed for review, subsequent transmittal and ordering of required products for fabrication, delivery and installation. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Architect's and Contractor's final release or approval.

C. The Contractor is to deliver the submittals as outlined below, from the date of the Notice to Proceed. There shall be deducted from any amount due, or that may become due the Contractor, a sum of $100.00 per day per submittal for each and every day beyond the dates listed below from the Notice to Proceed. Such sum is fixed and agreed upon by the DFCM and the Contractor as liquidated damages due the DFCM by reason of the inconvenience and added costs of administration of the contract, engineering, supervision and other costs resulting from the Contractor's default, and not as a penalty.

1. 60 days for Structural, Site Utilities and Infrastructure, Masonry, Boilers, Chillers, Fire Sprinkler, Transformers, Switchgear and any other extended lead time item
2. 90 days for Doors, Frames, Hardware Storefront, Curtainwall and Glazing, Roofing, Air Barriers and Exterior Wall components
3. 120 days for Lighting, Mechanical Equipment, and Plumbing Fixtures, interior Wall Components
4. 150 days for Finishes
5. 180 days for Exterior Improvements, Landscaping, and any remaining items not listed above.
6. 90 days for all deferred submittals including re-submittals

1.5 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals. Instead, the Building Information Model will be made available for use by affected subcontractors to incorporate their work with other trades. This will include, at a minimum, the structural steel, mechanical, plumbing, electrical, life safety systems, etc.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Submittals must be complete. Partial submittals will not be reviewed. Submittals that have clearly not been reviewed by the General Contractor will be returned.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

   a. **Architect reserves** the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on **Architect's** receipt of submittal.

1. Initial Review: Allow 10 business days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow 15 business days for initial review of each submittal.

3. Direct Transmittal to Consultant: Where the Contract Documents indicate that submittals may be transmitted directly to Architect's consultants, provide duplicate copy of transmittal to Architect. Submittal will be returned to Architect before being returned to Contractor.

4. If intermediate submittal is necessary, process it in same manner as initial submittal.
5. Allow 10 additional days for processing each resubmittal.
6. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

D. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately **4 by 5 inches (100 by 125 mm)** on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information on label for processing and recording action taken:

   a. Project name.
   b. Date.
   c. Name and address of Architect
   d. Name and address of Contractor.
   e. Name and address of subcontractor, if any
   f. Name and address of supplier.
   g. Name of manufacturer.
   h. Unique identifier, including revision number.
   i. Number and title of appropriate Specification Section.
   j. Drawing number and detail references, as appropriate.
   k. Other necessary identification.

E. Deviations: Notify the Architect in writing with a letter attached to the submittal of any deviations in the submittal from requirements of the Contract Documents. Product substitutions must be proposed in writing prior to submission of any shop drawings, product data in accordance with other Division 1 sections.

F. Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.

G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will **return submittals, without review,** received from sources other than General Contractor.

1. On a separate sheet included with each submittal, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.
2. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.
3. Transmittal Form: Provide locations on form for the following information:

a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of subcontractor, manufacturer, and supplier.
f. Category and type of submittal.
g. Submittal purpose and description.
h. Submittal and transmittal distribution record.
i. Remarks.
j. Signature of transmitter.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Use only final submittals with mark indicating action taken by Architect in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Submit one PDF file of each submittal to the Architect and one PDf file to WSU, unless otherwise indicated. Architect will return marked-up PDF file where applicable. Retain a copy as a Project Record Document in paper format for site use.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Standard color charts. (Color reproduction required)
e. Manufacturer's catalog cuts.
f. Wiring diagrams showing factory-installed wiring.
g. Printed performance curves.
h. Operational range diagrams.
i. Standard product operating and maintenance manuals.
j. Compliance with recognized trade association standards.
k. Compliance with recognized testing agency standards.
l. Application of testing agency labels and seals.
m. Notation of coordination requirements.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Include the following information, as applicable:

a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
f. Shopwork manufacturing instructions.
g. Templates and patterns.
h. Schedules.
i. Design calculations.
j. Compliance with specified standards.
k. Notation of coordination requirements.
l. Notation of dimensions established by field measurement.

2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (750 by 1070 mm).
4. Submit each submittal, as follows:

a. Initial Submittal: Submit one PDF file to Architect, one copy to WSU. Architect, will return a marked-up PDF file.
b. Final Submittal: Submit one PDF file to Architect, one PDf file copy to WSU. Submit prints as required for operation and maintenance manuals. **Mark up and retain one returned print as a Project Record Drawing.**
c. **Provide one hard copy of large shop drawings submittals. (Greater than 20 sheets)**

D. Coordination Drawings: Comply with requirements in Division 1 Section "Project Management and Coordination."

E. Samples: Prepare physical units of materials or products, including the following:

1. Comply with requirements in Division 1 Section "Quality Requirements" for mockups.
2. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

3. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
4. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:

    a. Generic description of Sample.
    b. Product name or name of manufacturer.
    c. Sample source.

5. Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, provide the following:

    a. Size limitations.
    b. Compliance with recognized standards.
    c. Availability.
    d. Delivery time.

6. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
    a. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.

7. Number of Samples for Initial Selection: Submit **two full sets** of available choices where establishment of a level of quality is required to be selected from manufacturer's product line. Architect will return submittal with options selected.

8. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

F. Contractor's Construction Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for Construction Manager's action.

G. Application for Payment: Comply with requirements in Division 1 Section "Payment Procedures."

H. Schedule of Values: Comply with requirements in Division 1 Section "Payment Procedures."

I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Submit one copy of each submittal, unless otherwise indicated. Architect will not return copies.
2. Certificates and Certifications: Provide a notarized statement that includes signature of Contractor, testing agency, or design professional responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of the company.
3. Test and Inspection Reports: Comply with requirements in Division 1 Section "Quality Requirements."

B. Contractor's Construction Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."

C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.

H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.

I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.

J. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.

K. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.

L. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

M. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

N. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 1 Section "**Closeout Procedures**."

O. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable.

P. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

Q. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

R. Material Safety Data Sheets: Submit information directly to Owner. If submitted to Architect, Architect will not review this information but will return it with no action taken.

S. LEED Credit Data: Highlight required information and /or separate LEED documentation.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect .

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. General: ARCHITECT WILL NOT REVIEW SUBMITTALS THAT DO NOT BEAR CONTRACTOR'S APPROVAL STAMP AND WILL RETURN THEM WITHOUT ACTION.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.

C. Informational Submittals: Architect will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

3.3 DEFERRED SUBMITTALS

A. After Final review by the Architect, submit two printed copies of all deferred submittals to the Architect for transmittal to the Building Official.

END OF SECTION 013300

License and Indemnification Agreement

Project: RESIDENTIAL LIFE PHASE 2 BUILDING 2 WEBER STATE UNIVERSITY

MHTN Project Number: 2010543.00

In response to the Receiver's request to obtain Drawings, Specifications, electronic data, and/or other Instruments of Service (the "Information") produced by MHTN Architects, Inc. ("MHTN") for the above referenced project, MHTN and the Receiver agree to the following:

Receiver's authorized representative to initial Receiver's assent to each term in the space provided.

_____ 1. MHTN grants to the Receiver a non-exclusive license to the Information for production of the Receiver's portion of the work for this project only. The Receiver shall not transfer or assign this license. MHTN retains its copyrights, the right to retain electronic data or other reproducible copies of the Information, and the right to use information, ideas, and/or concepts contained in the Information in the normal course of the its professional activities.

_____ 2. The Information is for information purposes only. Under no circumstances shall the conveyance of the Information be deemed a sale by MHTN. MHTN makes no warranties, express or implied, of merchantability or of fitness of the Information for a particular purpose.

_____ 3. The Receiver shall remove all title blocks and other references to MHTN, MHTN's consultants, and the project owner from the electronic data contained in the Information upon receipt.

_____ 4. The Receiver shall remove all notes, text, and detail cuts from the electronic data contained in the Information upon receipt.

_____ 5. Use of the Information shall be at Receiver's sole risk and without liability to MHTN or its consultants. The Receiver shall make no claim against MHTN or its consultants. The Receiver shall defend, indemnify, and hold harmless MHTN, MHTN's consultants, and agents and employees of any of them from and against all claims, damages, losses, and expenses, including but not limited to attorney fees and costs, arising out of the Receiver's use of the Information.

Receiver Company Name: _____

Officer & Title (printed): _____

Officer & Title (signed): _____

Date: _____

_____

MHTN Architects, Inc.

Representative & Title (printed): _____

Representative & Title (signed): _____

Date: _____

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Mock-ups specified in other specification sections establish a level of quality for appearance, and workmanship as specified herein.

C. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

D. Related Sections include the following:
1. Division 1 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
2. Divisions 2 through 32 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. **Mockups establish the standard by which the Work will be judged.**
1. The same field workers used in the construction of Mock-ups must be utilized for construction of the assembly on the structure.

2. Craftsmen exhibiting poor craftsmanship must be replaced with qualified personnel immediately.
3. Craftsmen that are accepted are to remain on the Project until completion, without substitution or replacement.

D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.5 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

C. Schedule of Tests and Inspections: Whether the responsibility of Owner or Contractor, prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

D. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.

9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in Utah, and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.

G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

H. Preconstruction Testing: Testing agency shall perform preconstruction testing for compliance with specified requirements for performance and test methods.

1. Contractor responsibilities include the following:

a. Provide test specimens and assemblies representative of proposed materials and construction. Provide sizes and configurations of assemblies to adequately demonstrate capability of product to comply with performance requirements.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Fabricate and install test assemblies using installers who will perform the same tasks for Project.
d. When testing is complete, remove assemblies; do not reuse materials on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect Seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the **Contract Sum will be adjusted by Change Order**.

B. Contractor Responsibilities: On a limited basis as specified, the Contractor may provide quality-control services specified and required by authorities having jurisdiction.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least **24** hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Special Tests and Inspections: Owner will engage a testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

1. Testing agency will notify Architect, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
3. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
5. Testing agency will retest and reinspect corrected work.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
5. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field-curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 10 days of date established for **commencement of the Work**.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.
2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": The term "approved," when used in conjunction with Architect's action on Contractor's submittals, applications, and requests, is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by Architect, requested by Architect, and similar phrases.

D. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on Drawings; or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference.

E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": The term "furnish" means to supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": The term "install" describes operations at Project site including unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.

I. "Installer": An installer is Contractor or another entity engaged by Contractor, as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations.

J. The term "experienced," when used with the term "installer," means having successfully completed a minimum of **five** previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

K. "Project site" is the space available for performing construction activities, either exclusively or in conjunction with others performing other work as part of Project. The extent of Project site is shown on the Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of the date of the Contract Documents, unless otherwise indicated.

C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to Architect for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from the publication source and make them available on request.

E. Abbreviations and Names: Abbreviations and acronyms are frequently used in the Specifications and other Contract Documents to represent the name of a trade association, standards-developing organization, authorities having jurisdiction, or other entity in the context of referencing a standard or publication. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of these entities. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S.," which are available in most libraries.

PART 2 - PRODUCTS -

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 014533 – STRUCTURAL TESTS AND SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes administrative and procedural requirements required for compliance with the International Building Code, Chapter 17, Structural Tests and Special Inspections.

B. Structural testing and special inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve contractor of responsibility for compliance with other construction document requirements.

1. Specific quality-assurance and control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and control procedures that facilitate compliance with the construction document requirements.
3. Requirements for contractor to provide quality-assurance and control services required by architect, owner, or authorities having jurisdiction are not limited by provisions of this section.

C. The owner will engage one or more qualified special inspectors and/or testing agencies to conduct structural tests and special inspections specified in this section and related sections and as maybe specified in other divisions of these specifications.

D. Related Sections include but are not limited to the following;

1. 033000 CAST-IN-PLACE CONCRETE
2. 042000 UNIT MASONRY ASSEMBLIES
3. 051200 STRUCTURAL STEEL
4. 052100 STEEL JOIST FRAMING
5. 053100 STEEL DECK
6. 054000 COLD-FORMED METAL FRAMING
7. 055000 METAL FABRICATION
8. 055100 METAL STAIRS
9. 312000 EARTH WORK
10. SPRAYED FIRE-RESISTANT MATERIALS
11. POST INSTALLED CONCRETE AND MASONRY ANCHORS
12. AIR BARRIER

All items requiring special inspection are listed in the special inspection schedule in the general drawings.

E. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the building official.

F. Construction Documents: Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a building permit. Construction Documents include all supplemental instruction, sketches, addenda, and revisions to the drawings and specifications issued by the registered design professional beyond those issued for a building permit.

G. Shop Drawings / Submittal Data: Written, graphic and pictorial documents prepared and / or assembled by the contractor based on the Construction Documents.

H. Structural Observations: Visual observation of the structural system by a representative of the registered design professional's office for the general conformance to the approved construction documents. Structural observations are not considered part of the structural tests and special inspections and do not replace inspections and testing by the testing agency or special inspector.

I. Special Inspector: A qualified person who demonstrating competence, to the satisfaction of the code enforcement official and registered design professional in responsible charge, for inspection of the particular type of construction or operation requiring special inspection. The special inspector shall be a licensed professional engineer or engineering intern or a qualified representative from the testing agency.

J. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

K. Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been ort is being performed and at the completion of the work.

L. Testing Agency: A qualified materials testing laboratory under the responsible charge of a licensed professional engineer, approved by the code enforcement official and the registered design professional in responsible charge, to measure, examine, test, calibrate, or otherwise determine the characteristics or performance of construction materials and verify confirmation with construction documents.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. Minimum qualifications of inspection and testing agencies and their personnel shall comply with ASTM E329-03 Standard Specification for agencies on the Testing and / or Inspection of Materials used in construction.

   a. Inspectors and individuals performing tests shall be certified for the work being performed as outlined in the appendix of the ASTM E329. Certification by organizations other than those listed must be submitted to the building official for consideration before proceeding with work.

2. In addition to these requirements, local jurisdiction may have additional requirements. It is the responsibility of the testing and inspection agencies to meet local requirements and comply with local procedures.

1.4 CONFLICTING REQUIREMENTS, REPORTS AND TEST RESULTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to the registered design professional in responsible charge for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to the registered design profession in responsible charge for a decision before proceeding.

C. The special inspector's reports and testing agencies results shall have precedence over reports and test results provided by the contractor.

D. Where a conflict exists between the construction documents and approved shop drawings / submittal data, the construction documents shall govern unless the shop drawings / submittal data are more restrictive. All conflicts shall be brought to the attention of the registered design professional in responsible charge.

1.5 SUBMITTAL BY SPECIAL INSPECTOR AND / OR TESTING AGENCY

A. Special inspectors shall keep and distribute records of inspections. The special inspector shall furnish inspection reports to the building official, and to the registered design professional in responsible charge, contractor, architect, and owner. Reports shall indicate that work inspected was done in conformance to approved construction documents. Discrepancies shall be brought to the immediate attention of the contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the contractor for correction. If the discrepancies are not corrected the discrepancies shall be brought to the attention of the building official and to the registered design professional in responsible charge prior to the completion of that phase of the work. A final report documenting required special inspections and correction of any discrepancies noted in the inspections shall be submitted at a point in time agreed upon by the permit applicant and the building official prior to the start of work.

1. Special inspection report and test results shall include, but not be limited to, the following:

a. Date of inspection.

b. Description of inspections or tests performed including location (reference grid lines, floors, elevations etc.).

c. Statement noting that the work, material and / or product conforms or does not conform to the construction document requirements.

1) Name and signature of contractor's representative who was notified of work, material, and / or products that do not meet the construction document requirements.

d. Name and signature of special inspector and / or testing agency representative performing the work.

B. Schedule of Non-Compliant Work: Each agent shall maintain a log of work that does not meet the requirements of the construction documents. Include reference to the original inspection / test report and subsequent dates of re-inspection / retesting.

C. Reports and tests shall be submitted within 1 week of inspection or test. Schedule of Non-Compliant Work shall be updated daily and submitted on monthly intervals.

D. Final report of Special Inspections. Submitted by each agent listed in the schedule of Structural Testing and Special Inspections.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONTRACT RESPONSIBILITY

A. The contractor shall coordinate the inspection and testing services with the progress of ther work. The contractor shall provide sufficient notice to allow proper scheduling of all personnel. The contractor shall provide safe access for performing inspection and on site testing.

B. The contractor shall submit schedules to the owner, registered design professionals and testing and inspecting agencies. Scheduled will note milestones and durations of time fort materials requiring structural tests and special inspections.

C. Each contractor responsible for the construction of a seismic-force-resisting system, designated seismic system, or component listed in the quality assurance plan shall submit written contractor's statement of responsibility to the building official and the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain the following:

1. Acknowledgement of awareness of the special requirements contained in the quality assurance plan.
2. Acknowledgement that control will be exercised to obtain conformance with the construction documents approved by the building official.
3. Procedures for exercising control within the contractor's organization, the method and frequent of reporting and the distribution of the reports.
4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.

D. Each contractor responsible for the construction of a main windforce-resisting system, or a wind-resisting component listed in the quality assurance plan shall submit a written statement of responsibility to the building official and owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain the following:

1. Acknowledgement of awareness of the special requirements contained in the quality assurance plan.

2. Acknowledgement that control will be exercised to obtain conformance with the construction documents approved by the building official.
3. Procedures for exercising control within the contractor's organization, the method and frequent of reporting and the distribution of the reports.
4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.

E. The contractor shall repair and / or replace work that does not meet the requirements of the construction documents.

1. Contractor shall engage an engineer / Architect to prepare repair and / or replacement procedures.
2. Engineer / Achitect shall be registered in the state in which the project if located. Engineer shall be acceptable to the registered design professional in responsible charge, code enforcement official, and owner.
3. Procedures shall be submitted for review and acceptance by the registered design professional in responsible charge, code enforcement official and owner before proceeding with corrective action.

F. The contractor shall be responsible for costs of:

1. Re-testing and re-inspection of materials, work and / or products that do not meet the requirements of the construction documents and shop drawings / submittal data.
2. Review the proposed repair and / or replacement procedures by the registered design professional in responsible charge and the inspectors and testing agencies.
3. Repair or replacement of work that does not meet the requirements of the construction documents.

3.2 STRUCTURAL OBSERVATIONS

A. Structural observations may be made periodically as determined by the registered deign professional in responsible charge.

3.3 TESTING AND INSPECTION

A. Testing and inspection shall be in accordance with the attached Schedule of Special Inspections.

B. Reference related specifications for the minimum level of inspections and testing. Provide additional inspections and testing as necessary to determine compliance with the construction drawings.

PART 4 - SCHEDULES AND FORMS (ATTACHED)

4.1 SCHEDULES OF SPECIAL INSPECTIONS.

END OF SECTION 014533

SECTION 014620 - FIRE RATED ASSEMBLIES

Part 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Construction requirements for fire rated assemblies for decisions affecting the work.

C. Testing and inspecting serviced are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract document requirements.

1. Specific quality –control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in these Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for the Contractor to provide quality-control services requires by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

D. Related Sections include the following:

1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
2. Division 2 through 26 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate the completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect or Construction Manager.

C. Testing Agency: An entity engaged to perform specific tests, inspection, or both. Testing laboratory shall mean the same as testing agency.

1.4 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contract by Contract Documents, provide products and systems complying with specific performance and design criteria included.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Structural framing plans indicating the following:

1. Locations and typed of surface preparations required before applying sprayed fire-resistive material.
2. Extent of fire-resistive material for each construction and fire-resistance rating, including the following:

   a) Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable authorities having jurisdiction.
   b) Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.

C. Product Certificates: For each type of fire-resistive material, signed by product manufacturer.

D. Qualification Data: For Installer, manufacturer and testing agency.

E. Compatibility and Adhesion Test Reports: From material manufacturer, as applicable, indicating the following:

1. Materials have been tested for bon with substrates.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Product test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity and ability to produce required units.

B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service construction.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements for specialists shall not supersede building codes and similar regulations governing the Work nor interfere with local trade-union jurisdictional settlements and similar conventions.

G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspection indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In Part 2 articles of individual specification sections, the following requirements apply for product selections:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work are defined in applicable specification sections for fire rated assemblies.

PART 3 – SCHEDULE OF LISTED FIRE RATED ASSEMBLIES is indicated on the Drawings

END OF SECTION 014620

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

B. Responsibility for temporary facilities will be assigned by the Construction Manager to subcontractors based upon areas of expertise.

C. Temporary utilities include, but are not limited to, the following:
   1. Water service distribution.
   2. Sanitary facilities, including toilets.
   3. Ventilation.
   4. Heat
   5. Electric power distribution service.
   6. Lighting.
   7. Telephone service.

D. Support facilities include, but are not limited to, the following:
   1. Temporary signs.
   2. Waste disposal facilities.
   3. Field offices.
   4. Project sign with color rendering

E. Security and protection facilities include, but are not limited to, the following:
   1. Tree and plant protection.
   2. Temporary Enclosures for existing construction.

F. Related Sections include the following:
   1. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
   2. Division 1 Section "Execution Requirements" for progress cleaning requirements.
   3. Divisions 2 through 16 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 USE CHARGES

A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
   1. Architect.
   2. Testing agencies.

3. Personnel of authorities having jurisdiction.

B. Contractor will be allowed to use campus utilities for construction. The terms for use are that the contractor install a meter at all connection points, and the contractor will pay for all utility usage. Billing will be at WSU's rate.

C. There will be installation fees for phone and data.

B. Water Service: Provide service extension from point of service for project site. The Contractor will be responsible for providing the tap and extending service for construction operations.

C. Temporary Heat: The University will provide access to the campus –wide gas distribution system, The Contractor is responsible to install and establish a metered point of service for the project. Charge for meter set and tap, and usage will be borne by the Contractor.

D. Electric Power Service: Use electric power from service location established for the work.

1.4 SUBMITTALS

A. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation and termination of each temporary utility.

1.5 QUALITY ASSURANCE

A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.

1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.

1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:

1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the Work.

3. Disconnect by General Contractor upon completion of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.

B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm) 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide **concrete** bases for supporting posts where fencing is portable.

C. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.

D. Water: Potable.

2.2 EQUIPMENT

A. General: Provide equipment suitable for use intended.
1. Field Offices: **Mobile units** with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading

B. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

C. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

D. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Connect to existing campus service in place

1. Avoid interruptions in service to make connections for temporary services.
2. Provide adequate capacity at each stage of construction.

B. Water Service: Use water service facilities from service tap for the project established by the General Contractor. Upon Substantial Completion, restore disturbed facilities to condition existing before initial use.

1. Provide rubber hoses as necessary to serve Project site.
2. As soon as water is required at each level, extend service to form a temporary water- and fire-protection standpipe. Provide distribution piping. Space outlets so water can be reached with a 100-foot (30-m) hose. Provide one hose at each outlet.

3. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of existing facilities will not be permitted while school is in session.
3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.

   a. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.

D. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.

1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
2. Provide warning signs at power outlets other than 110 to 120 V.
3. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or other traffic areas.
4. Provide metal conduit enclosures or boxes for wiring devices.
5. Provide 4-gang outlets, spaced so 100-foot (30-m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.

E. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Provide one 100-W incandescent lamp per 500 sq. ft. (45 sq. m), uniformly distributed, for general lighting, or equivalent illumination.
3. Provide one 100-W incandescent lamp every 50 feet (15 m) in traffic areas.
4. Provide one 100-W incandescent lamp per story in stairways and ladder runs, located to illuminate each landing and flight.
5. Install exterior-yard site lighting that will provide adequate illumination for construction operations, traffic conditions, and signage visibility when the Work is being performed.

F. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station.

1. At each telephone, post a list of important telephone numbers.

   a. Police and fire departments.
   b. Ambulance service.
   c. Contractor's home office.
   d. Architect's office.
   e. Engineers' offices.
   f. Owner's office.
   g. Principal subcontractors' field and home offices.

2. Provide **voice-mail service or answering machine** on Superintendent's telephone.
3. Furnish superintendent with cell phone for use when away from field office.

G. Internet connection on Site: Provide full e-mail service and internet connection on-site for use in communicating with Architect.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.

3. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes complying with University's requriements. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.

1. Engage an experienced sign painter to apply graphics for Project identification sign; approx. 4' x 8' x ¾" plywood. Comply with details furnished by Architect. Architect will also provide an electronic file with project rendering to be included on the sign.
2. Prepare temporary signs to provide directional information to construction personnel and visitors.
3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood of at least one sheet of ¾ inch thick material. Support on posts or framing of preservative-treated wood or steel.
4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
5. Content and location of directional signs will be at the direction of the Owner.

C. Janitorial Services: Provide janitorial services on a daily basis for temporary offices, first-aid stations, toilets, wash facilities, lunchrooms, and similar areas and areas of the facility affected by the Work.

D. Common-Use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel at Project site. Keep office clean and orderly.
1. Provide fluorescent light fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height. Provide 110- to 120-V duplex outlets spaced at not more than 12-foot (4-m) intervals, 1 per wall in each room.

E. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.

1. Construct framing, sheathing, and siding using fire-retardant-treated lumber and plywood.
2. Paint exposed lumber and plywood with exterior-grade acrylic-latex emulsion over exterior primer.

F. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

B. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to **erosion- and sedimentation-control Drawings or requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent**.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from the project site during the course of the project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Security Enclosure and Lockup: Install substantial temporary enclosure around exterior work and partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security when exterior openings are created in the course of the work.

F. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.

1. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch- (16-mm-) thick exterior plywood.

G. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
2. Vertical Openings: Close openings of 25 sq. ft. (2.3 sq. m) or less with plywood or similar materials.
3. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
4. Where temporary wood or plywood enclosure exceeds 100 sq. ft. (9.2 sq. m) in area, use fire-retardant-treated material for framing and main sheathing.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Watering of trees, shrubs, grass

C. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary site fencing.
2. Division 31 Section "Site Clearing" for removing existing trees and shrubs.

1.3 DEFINITIONS

A. Caliper: Tree-trunk diameters are measured at breast height (termed diameter at breast height or DBH), defined as the diameter of the tree 4-1/2 feet above ground on the uphill side of the tree. If a tree forks below breast height, each trunk is treated as a separate tree. DBH can be measured with a tree caliper, a Biltmore stick, a tree diameter tape, or a flexible measuring tape (e.g., cloth or steel). Tree calipers, Biltmore sticks, and tree-diameter tapes can be purchased through forestry equipment supply companies. The flexible measuring tape can be used to measure tree trunk circumference and circumference divided by 3.14 to determine diameter.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, shall be **defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line as a standard unless otherwise indicated** on the Drawings. A radius of 1.0 times the diameter of the drip line is the minimum shown on the tree protection plan.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of the following:

1. Organic Mulch: **1-quart (1-L)** volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
2. Protection-Zone Fencing: Assembled Samples of **manufacturer's standard size made from full-size components** 6'-0" high
3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

C. Tree Construction Access Schedule: Written schedule detailing scope and extent of construction operations around trees to remain that interfere with or are affected by construction. Any work proposed within the drip line of any tree will require adequate root protection which may include mulch or sheets of plywood. All proposed work shall be reviewed and approved by the University Project Manager and University Arborist.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for construction operation.
4. Description of agreed upon scope of work to be performed.
5. Description of maintenance following construction operations.

D. Trees, shrubs and grass Water Schedule: All existing landscaping to be protected shall be watered a minimum of (3) three times per week. Appendix 'B' Tree Watering Schedule is to be submitted every week indicating the days that the contractor proposed to water trees. The owner will field verify watering onsite.

E. Existing Conditions: This contract shall be required to photo document all existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or videotape. Photograph each tree from a minimum of three points to detail the entire circumference of the tree.
2. Include plans and notations to tie a specific tree to a specific location.

1.5 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at **Project site**

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

   a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
   b. Enforcing requirements for protection zones.
   c. Contractor responsibilities.
   d. University Arborist responsibilities
   e. Field quality control.
   f. Tree Watering Schedule

1.6 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.

4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, sandy loam; reasonably free of subsoil, clay lumps, gravel, and other objects more than **1/2 inch (12.5 mm)** in diameter; and free of weeds, roots, and toxic and other nonsoil materials.

1. Refer to section 032800 for topsoil requirements.

B. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements.

1. Chain-Link Protection-Zone Fencing: **Galvanized-steel** fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with 'T' type fence posts, with tie wires, hog ring ties, and other accessories for a complete fence system.

a. Height: **6 feet (1.8 m)**.

C. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:

1. Size and Text: 12" x 18" with Text "Tree Protection Zone".
2. Lettering: **2-inch- (50-mm-)** high minimum, red characters on **white** background.

D. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, available from Diamond trees red brown tree mulch

1. Type: Composted **Wood and bark chips from Diamond trees or approved equal.**
2. Size Range: **1/2 inch (13 mm) maximum**.
3. Color: Red/Brown

E. Water: **Potable water**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees vegetation to remain. Flag with **a 1-inch (25-mm) blue-vinyl tape around** each tree trunk at 54 inches (1372 mm) above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

Tree-Protection Zones: Mulch areas inside tree driplines where construction operations occur with a minimum of **4-inch (100-mm)** average thickness of organic mulch. Do not place mulch within 12 **inches (300 mm)** of tree trunks.

3.3 TREE- AND PLANT-PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones **before materials or equipment are brought on the site and demolition operations begin** in a manner that will prevent people and or construction operations from easily entering protected area. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
2. Posts: Drive ‘T’ posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect. Verify location of main and lateral irrigation lines with the University prior to post installation.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every **50 feet (15 m)** on protection-zone fencing, but no fewer than two signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

D. Repair or replace trees or vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect, Universtiy Project Manager and University Arborist.

E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and University and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones, inside the drip zone and for trenches indicated within protection zones according to requirements in Division 31 Section "Earth Moving" and as defined by the Universtiy Arborist in the Preconstruction Meeting

B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

A. All root pruning will be supervised by the University Arborist, no exceptions. Contact the University Project Manager prior to any construction operation within a tree drip zone.

B. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
1. Cover exposed roots with burlap and water regularly.
2. Backfill as soon as possible according to requirements in Division 31 Section "Earth Moving."

C. Root Pruning at Edge of Protection Zone: Prune roots **flush with the edge** of the protection zone, by cleanly cutting all roots to the depth of the required excavation.

D. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems as directed by the University Arborist. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.6 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 1 **inches (25 mm)** or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.7 FIELD QUALITY CONTROL

A. Inspections: The Universtiy Project Manager and Arborist stall be contacted on as needed basis and shall approve of plant-protection measures in the vicinity of trees and other vegetation indicated to remain and to prepare inspection reports.

B. Temporary Watering: All trees to be protected shall be watered as submitted in the watering schedule contractor shall check each tree and indicate duration of watering. Owner to be onsite to veryify.

3.8 REPAIR AND REPLACEMENT

A. General: Repair or replace trees and other vegetation indicated to remain that are damaged by construction operations, in a manner approved by University Project Manager and Architect.

1. Submit details of proposed tree repairs.
2. Contact the University Project manager and arborist immediately if any tree to remain is damaged.
3. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by the University Project Manager and Architect.

B. Trees Appraisal: The University personnel have numbered each tree noted to remain and have ascertained by the guidelines set forth from the Council of Tree and Landscape Appraisers, the value of each tree. The trunk formula has been used to ascertain the tree value. The value of each tree is attached in appendix “A”. This contract shall bear the full cost of any tree removed, damaged, destroyed or harmed at the sole discretion of the Owner.

1. Provide new trees of same size and species as those being replaced for each tree that measures **4-inch (100-mm)** or smaller in caliper size. **Species selected by the Owner.**
2. Provide **one** new tree of **4-inch (100-mm)** caliper size for each tree being replaced that measures more than **4 inches (100 mm)** in caliper size. The value of the 4” caliper tree will be deducted from the full replacement cost of the damaged tree as outlined in Appendix A. **Species selected by the Owner.**

C. Soil Aeration: Where directed by the Owner and Architect, aerate surface soil compacted during construction. Aerate **10 feet (3 m)** beyond the drip line and no closer than 48 **inches**

(1200 mm) to tree trunk. Drill **2-inch- (50-mm-)** diameter holes a minimum of 12 inches (300 mm) deep at **24 inches (600 mm)** o.c. Backfill holes with an equal mix of augered soil and sand.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

3.10 WATERING

A.. The campus irrigation system may or may not be operable at any give time. If campus system is not operable to complete landscaping or watering, provide water from a mobile source (water truck, etc.)

WEBER STATE UNIVERSITY				
CAMPUS TREE INVENTORY				
Residential Housing		**Date: 02/22/2011**		
ID#	**Tree Species**	**Common Name**	**Trunk Method**	**Replacement**
1	Picea pungens	Colorado Blue Spruce	$ 4,445.10	
2	Picea pungens	Colorado Blue Spruce	$ 3,124.58	
4	Picea pungens	Colorado Blue Spruce	$ 10,408.37	
5	Picea pungens	Colorado Blue Spruce	$ 10,678.31	
6	Picea pungens	Colorado Blue Spruce	$ 8,100.00	
7	Picea pungens	Colorado Blue Spruce	$ 13,200.00	
10	Ulmus rubra	Slippery Elm	$ 6,700.00	
11	Ulmus rubra	Slippery Elm	$ 10,400.00	
12	Fraxinus americana	White Ash	$ 8,300.00	
13	Fraxinus americana	White Ash	$ 4,230.00	
14	Fraxinus americana	White Ash	$ 2,180.00	
15	Fraxinus americana	White Ash	$ 4,300.00	
16	Betula papyrifera	Paper Birch	$ 5,800.00	
17	Betula papyrifera	Paper Birch	$ 5,300.00	
18	Betula papyrifera	Paper Birch	$ 3,720.00	
20	Gleditsia triacanthos	Honeylocust	$ 2,600.00	
21	Ulmus rubra	Slippery Elm	$ 1,900.00	
24	Picea pungens	Colorado Blue Spruce	$ 12,400.00	
25	Ulmus rubra	Slippery Elm	$ 6,800.00	
26	Ulmus rubra	Slippery Elm	$ 7,600.00	
27	Picea pungens	Colorado Blue Spruce	$ 5,200.00	
28	Ulmus rubra	Slippery Elm	$ 10,900.00	
29	Sophora japonica	Japenese pagodatree	$ 2,930.00	
30	Sophora japonica	Japenese pagodatree	$ 8,700.00	
39	Acer	Maple	$ 1,880.00	
40	Acer	Maple	$ 2,010.00	
41	Malus	Crabapple	$ 3,820.00	
42	Malus	Crabapple	$ 3,570.00	
43	Malus	Crabapple	$ 6,620.00	
44	Malus	Crabapple	$ 1,620.00	
45	Malus	Crabapple	$ 5,700.00	
47	Malus	Crabapple	$ 5,300.00	
60	Sophora japonica	Japenese pagodatree	$ 14,600.00	
64	Ulmus rubra	Slippery Elm	$ 6,900.00	
77	Pinus nigra	Austrian Pine	$ 13,100.00	

WEBER STATE UNIVERSITY
CAMPUS TREE INVENTORY
Residential Housing
Date: 01/07/2011

ID	Tree Species	Common name	week 1							week 2							week 3							week 4						
			date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date	date
1	*Picea pungens*	Colorado Blue Spruce																												
2	*Picea pungens*	Colorado Blue Spruce																												
3	*Picea pungens*	Colorado Blue Spruce																												
4	*Picea pungens*	Colorado Blue Spruce																												
5	*Picea pungens*	Colorado Blue Spruce																												
6	*Picea pungens*	Colorado Blue Spruce																												
7	*Picea pungens*	Colorado Blue Spruce																												
10	*Ulmus rubra*	Slippery Elm																												
11	*Ulmus rubra*	Slippery Elm																												
12	*Fraxinus americana*	White Ash																												
13	*Fraxinus americana*	White Ash																												
14	*Fraxinus americana*	White Ash																												
15	*Fraxinus americana*	White Ash																												
16	*Betula papyrifera*	Paper Birch																												
17	*Betula papyrifera*	Paper Birch																												
18	*Betula papyrifera*	Paper Birch																												
20	*Gleditsia triacanthos*	Honeylocust																												
21	*Ulmus rubra*	Slippery Elm																												
22	*N/A*	N/A																												
23	*Gleditsia triacanthos*	Honeylocust																												
24	*Picea pungens*	Colorado Blue Spruce																												
25	*Ulmus rubra*	Slippery Elm																												
26	*Ulmus rubra*	Slippery Elm																												
27	*Picea pungens*	Colorado Blue Spruce																												
28	*Ulmus rubra*	Slippery Elm																												
29	*Sophora japonica*	Japenese pagodatree																												
30	*Sophora japonica*	Japenese pagodatree																												
39	*Acer*	Maple																												
40	*Acer*	Maple																												

41	*Malus*	Crabapple																												
42	*Malus*	Crabapple																												
43	*Malus*	Crabapple																												
44	*Malus*	Crabapple																												
45	*Malus*	Crabapple																												
46	*Malus*	Crabapple																												
47	*Malus*	Crabapple																												
48	*Prunus*	American Plum																												
49	*Quercus gambelii*	Gambel Oak																												
50	*Quercus gambelii*	Gambel Oak																												
51	*Quercus gambelii*	Gambel Oak																												
52	*Pinus nigra*	Austrian Pine																												
53	*Pinus nigra*	Austrian Pine																												
54	*Picea pungens*	Colorado Blue Spruce																												
55	*Picea pungens*	Colorado Blue Spruce																												
56	*Platanus acerifolia*	London Planetree																												
57	*Platanus acerifolia*	London Planetree																												
58	*Platanus acerifolia*	London Planetree																												
59	*Pinus nigra*	Austrian Pine																												
60	*Sophora japonica*	Japenese pagodatree																												
64	*Ulmus rubra*	Slippery Elm																												
77	*Pinus nigra*	Austrian Pine																												

END OF SECTION 015639

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties;

B. Related Sections include the following:
   1. Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.
   2. Divisions 2 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility]. Products salvaged or recycled from other projects are not considered new products.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor are allowed only before bid, and will not be considered in the course of Construction.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design", “Design Standard” or similar, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
   1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
   2. Form: Tabulate information for each product under the following column headings:
      a. Specification Section number and title.
      b. Generic name used in the Contract Documents.
      c. Proprietary name, model number, and similar designations.
      d. Manufacturer's name and address.
      e. Supplier's name and address.
      f. Installer's name and address.
      g. Projected delivery date or time span of delivery period.
      h. Identification of items that require early submittal approval for scheduled delivery date.
   3. Initial Submittal: Within 5 days after date of commencement of the Work, submit 8 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
      a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
   4. Completed List: Within 7 days after date of commencement of the Work, submit 8 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
   5. Architect's Action: Architect will respond in writing to Contractor within 7 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
   1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
   2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
9. Protect stored products from damage.

B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures: Procedures for product selection include the following:
1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or “No Sub” name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
7. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Products" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
8. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
9. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
   a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
   b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Sections:

1. Division 01 Section "Submittal Procedures" for submitting surveys.
2. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
3. Division 02 Section "Selective Structure Demolition" for demolition and removal of selected portions of the building.
4. Division 07 Section "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate how long services and systems will be disrupted.

1.5 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from the Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

   a. Primary operational systems and equipment.
   b. Fire separation assemblies.
   c. Air or smoke barriers.
   d. Fire-suppression systems.
   e. Mechanical systems piping and ducts.
   f. Control systems.
   g. Communication systems.
   h. Conveying systems.
   i. Electrical wiring systems.
   j. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

   a. Water, moisture, or vapor barriers.
   b. Equipment supports.
   c. Piping, ductwork, vessels, and equipment.
   d. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities.

Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

B. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, utilize products for patching that comply with requirements of Division 01 Section "Sustainable Design Requirements."

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of mechanical and electrical systems, and other construction affecting the Work.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

   a. Description of the Work.
   b. List of detrimental conditions, including substrates.
   c. List of unacceptable installation tolerances.
   d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a **professional engineer** to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.
5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

D. Final Property Survey: Engage a **professional engineer** to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by **professional engineer**, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements of Division 01 Section "Summary."

E. Existing Mechanical/Electrical Systems: Where existing systems are required to be removed, relocated, or abandoned, bypass such systems before cutting to minimize interruption to occupied areas.

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
5. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

   a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

   a. Utilize containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Construction Wast Management"

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Sections:

1. Division 01 Section “Sustainable Design Requirements”
2. Division 02 Section "Selective Structure Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENT

A. General: *Achieve end-of-Project rates for salvage/recycling shall be 75 percent by weight* of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons (tonnes).
4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. LEED Submittal: LEED letter template for Credit MR 2.1 and 2.2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.

H. Qualification Data: For waste management coordinator and refrigerant recovery technician.

I. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of Projects with similar requirements, that employs a LEED

Accredited Professional, certified by USGBC, as waste management coordinator. Waste management coordinator may also serve as LEED coordinator.

B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609, complying with LEED credit requirements and requirements of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste and Form CWM-6 for demolition waste. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in hauling and tipping fees by donating materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

F. Plumbing Fixtures: Separate by type and size.

G. Lighting Fixtures: Separate lamps by type and protect from breakage.

H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

B. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

D. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

E. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

F. Carpet: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

G. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

H. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

3.7 ATTACHMENTS

A. Form CWM-1 for construction waste identification.

FORM CWM-1: CONSTRUCTION WASTE IDENTIFICATION

MATERIAL CATEGORY	GENERATION POINT	EST. QUANTITY OF MATERIALS RECEIVED* (A)	EST. WASTE - % (B)	TOTAL EST. QUANTITY OF WASTE* (C = A x B)	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Packaging: Cardboard							
Packaging: Boxes							
Packaging: Plastic Sheet or Film							
Packaging: Polystyrene							
Packaging: Pallets or Skids							
Packaging: Crates							
Packaging: Paint Cans							
Packaging: Plastic Pails							
Site-Clearing Waste							
Masonry or CMU							
Lumber: Cut-Offs							
Lumber: Warped Pieces							
Plywood or OSB (scraps)							
Wood Forms							
Wood Waste Chutes							
Wood Trim (cut-offs)							
Metals							
Insulation							
Roofing							
Joint Sealant Tubes							
Gypsum Board (scraps)							
Carpet and Pad (scraps)							
Piping							
Electrical							

Conduit							
Other:							

* Insert units of measure.

Form CWM-2 for demolition waste identification.

FORM CWM-2: DEMOLITION WASTE IDENTIFICATION

MATERIAL DESCRIPTION	EST. QUANTITY	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Asphaltic Concrete Paving				
Concrete				
Brick				
CMU				
Lumber				
Plywood and OSB				
Wood Paneling				
Wood Trim				
Miscellaneous Metals				
Structural Steel				
Rough Hardware				
Insulation				
Roofing				
Doors and Frames				
Door Hardware				
Windows				
Glazing				
Acoustical Tile				
Carpet				
Carpet Pad				
Demountable Partitions				
Equipment				
Cabinets				
Plumbing Fixtures				
Piping				
Piping Supports and Hangers				
Valves				
Sprinklers				
Mechanical Equipment				
Electrical Conduit				
Copper Wiring				
Light Fixtures				
Lamps				

Lighting Ballasts				
Electrical Devices				
Switchgear and Panel-boards				
Transformers				
Other:				

B. Form CWM-3 for construction waste reduction work plan.

FORM CWM-3: CONSTRUCTION WASTE REDUCTION WORK PLAN

MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Packaging: Cardboard						
Packaging: Boxes						
Packaging: Plastic Sheet or Film						
Packaging: Polystyrene						
Packaging: Pallets or Skids						
Packaging: Crates						
Packaging: Paint Cans						
Packaging: Plastic Pails						
Site-Clearing Waste						
Masonry or CMU						
Lumber: Cut-Offs						
Lumber: Warped Pieces						
Plywood or OSB (scraps)						
Wood Forms						

Wood Waste Chutes						
Wood Trim (cut-offs)						
Metals						
Insulation						
Roofing						
Joint Sealant Tubes						
Gypsum Board (scraps)						
Carpet and Pad (scraps)						
Piping						
Electrical Conduit						
Other:						

C. Form CWM-4 for demolition waste reduction work plan.

FORM CWM-4: DEMOLITION WASTE REDUCTION WORK PLAN

MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Asphaltic Concrete Paving						
Concrete						
Brick						
CMU						
Lumber						
Plywood and OSB						
Wood Panel-ing						
Wood Trim						
Miscellaneous Metals						
Structural Steel						

Rough Hardware						
Insulation						
Roofing						
Doors and Frames						
Door Hardware						
Windows						
Glazing						
Acoustical Tile						
Carpet						
Carpet Pad						
Demountable Partitions						
Equipment						
Cabinets						
Plumbing Fixtures						
Piping						
Supports and Hangers						
Valves						
Sprinklers						
Mechanical Equipment						
Electrical Conduit						
Copper Wiring						
Light Fixtures						
Lamps						
Lighting Ballasts						
Electrical Devices						
Switchgear and Panelboards						
Transformers						
Other:						

D. Form CWM-5 cost/revenue analysis of construction waste reduction work plan.

FORM CWM-5: COST/REVENUE ANALYSIS OF CONSTRUCTION WASTE REDUCTION WORK PLAN

MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								

Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

E. Form CWM-6 cost/revenue analysis of demolition waste reduction work plan.

FORM CWM-6: COST/REVENUE ANALYSIS OF DEMOLITION WASTE REDUCTION WORK PLAN

MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								

Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mech. Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								
Other:								

F. Form CWM-7 for construction waste.

FORM CWM-7: CONSTRUCTION WASTE REDUCTION PROGRESS REPORT

MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								

Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

G. Form CWM-8 for demolition waste.

FORM CWM-8: DEMOLITION WASTE REDUCTION PROGRESS REPORT

MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								

Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mechanical Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								
Other:								

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Sections:

1. Division 01 Section "Execution" for progress cleaning of Project site.
2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents,(As-Builts) operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.

9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
12. Complete final cleaning requirements, including touchup painting.
13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.

1. Organize list of spaces in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page:

   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Contractor.
   e. Page number.

4. Submit list of incomplete items in the following format (verify with Architect):

   a. PDF electronic file.
   b. Three paper copies of product schedule or list, unless otherwise indicated. Architect will return two copies.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

   1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
   4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site in areas disturbed by construction activities of rubbish, waste material, litter, and other foreign substances.
b. Remove tools, construction equipment, machinery, and surplus material from Project site.
c. Clean exposed interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition.
d. Remove debris and surface dust from limited access spaces, plenums, shafts and similar spaces.
e. Sweep concrete floors broom clean in unoccupied spaces.
f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
g. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
h. Remove labels that are not permanent.
i. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.

j. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint droppings, and other foreign substances.
k. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.

1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report upon completion of cleaning.

o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

p. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals in electronic and hard copies
5. Systems and equipment maintenance manuals.

B. Related Sections:
1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 01 Section "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.
3. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual specification sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Where applicable, clarify and update reviewed manual content to correspond to modifications and field conditions.

B. Format: Submit operations and maintenance manuals in the following format (verify with Architect):

1. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Architect.

    a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
    b. Enable inserted reviewer comments on draft submittals.

2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Agent will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Agent will return copy with comments.

1. Correct or modify each manual to comply with Architect's and Commissioning Agent's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Agent's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Agent.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

F. Provide Operation & Maintenance information in electronic format:

1. An intuitive **CD-ROM** instructional manual shall be provided to give the owners representative the information they need to care, adjust, maintain and operate all of the equipment within the building, to include but not limited to, the heating, air conditioning, ventilating, plumbing automatic temperature control systems, kitchen equipment, stage and theatrical equipment, electrical equipment and building products requiring maintenance.
2. An orientation date shall be set up to instruct the owner's representative on the use of the operation and maintenance **CD-ROM**. A written report specifying times, dates, and names of personnel instructed shall be forwarded to the owner's representative.
3. **CD-ROM** manual preparation shall be under the direction of an individual or organization that has demonstrated expertise in the preparation of a comprehensive and complete **CD-ROM** operation and maintenance manual. Qualifications shall be submitted for approval.
4. All **CD-ROM'**s shall be authored with Adobe Acrobat. The authoring shall, but not be limited to include the following:

a. All design drawings and documentation shall be included on the **CD-ROM** in a PDF format. These drawings shall be provided in an electronic format to the company contracted to create the **CD-ROM** and shall include the civil engineering, architectural, structural, electrical and mechanical sections.
b. Icons shall be located on the PDF plans to link test and balance reports and mechanical operation and maintenance information to the design drawings.
c. All information on the **CD-ROM** shall be printable on 8.5O x 11.O plain paper with the design drawings and automatic temperature control drawings printable on 11.O x 17.O plain paper.
d. Linked information such that the user can key work search for information.
e. Provide a hyper-text alphabetical index of all equipment and building products as outlined in item 1 above.
f. Use of multimedia formatting (text, pictures, graphics and sound etc.) will be used to make the information more accessible and understandable.
g. All documentation shall be converted to an unchangeable Portable Document Format (PDF).
h. The **CD-ROM** shall start automatically when inserted in the drive under the Windows 95 operation system. Any directions to continue will be observable on the screen.
i. Operation and maintenance information to be supplied to the company contracted to do the **CD-ROM** by the contractor and suppliers providing the materials and equipment.

5. At the beginning or start-up of the **CD-ROM** there shall be a General Information Index screen to direct the user to the portion of the manual desired. This index screen will consist of four (4) major groups. The groups will include:

a. Contract Developers: This section is to include:

1) Names of architects, engineers and contractors with address and telephone numbers.

b. Equipment List: This section to include:

1) A job specific alphabetical list of all items supplied to the project with names of the manufacturer, Item description including the plan number, model number and local supplier with current address and telephone number.

c. Design drawings
d. Manufacturer's Operation and Maintenance Manuals:

1) Architectural section: This section to include:

a. Building products, applied materials and finishes: Include product data with catalog number, size, composition, color and texture designations. Provide information for reordering custom manufactured products. Data shall include, but not limited to, information on carpet, floor tile, vinyl wall finishes, builders hardware, etc.
b. Instruction for care and maintenance to include manufacturer's recommendation for cleaning agents and methods, precaution against detrimental agents and methods and recommended schedule for cleaning and maintenance.

2) Mechanical section: This section to include items in Division 15:

a. A general description of the mechanical system.
b. A step by step procedure to follow in putting each piece of mechanical equipment into operation.
c. Schematic control diagrams for each separate fans system, heating system, control panel, etc. Each diagram shall show locations of all control and operating components and devices.
d. Test and balance report
e. Valve tag schedule
f. All manufacturers operation and maintenance manual information
g. Maintenance instructions: This portion shall include:

1. A summary list of mechanical equipment requiring lubrication showing name of equipment and type and frequency of lubrication.
2. Special Maintenance Instructions to be summarized as follows:

a. Preventative Maintenance Procedures
b. Seasonal start-up and shut-down maintenance
c. Periodical inspection requirements
d. Water treatment procedures

3) Electrical section: This section to include items in Division 16:

a. Building products, applied materials and equipment: Include product data with catalog number. Provide information for reordering custom manufactured products.
b. Instruction for care and maintenance to include all manufacturer's recommendations.

6. The minimum computer requirements to run the **CD-ROM** will be the following:

a. Pentium Processor 100 MHz
b. 16 Meg RAM
c. 4x **CD-ROM/DVD** drive
d. Sound Card
e. 64 bit 2 meg video card
f. Windows 95, 98 or 2000
g. Mouse
h. SVGA monitor
i. Monitor set to 800 x 600 resolution

7. Four (4) copies of the CD will be provided to the owner's representative.

G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf or post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name,and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."

F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals including LEED Submittals

B. Related Sections:
1. Division 01 Section "Execution" for final property survey.
2. Division 01 Section "Closeout Procedures" for general closeout procedures.
3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
4. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings(As Builts): Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal: Submit one paper copy set or PDF electronic files (verify with Architect) of marked-up record prints and one set of plots from corrected record digital data files. Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
b. Final Submittal: Submit one paper copy set or PDF electronic files (verify with Architect) of marked-up record prints. Print each Drawing, whether or not changes and additional information were recorded.
c. Final Submittal: Submit one paper copy set or PDF electronic files of marked-up record prints, one set(s) of record digital data files, and three set(s) of record digital data file plots. Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy or annotated PDF electronic files (verify with Architect) of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy or annotated PDF electronic files and directories (verify with Architect) of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy or annotated PDF electronic files and directories (verify with Architect) of each submittal.

E. Reports: Submit written report weekly indicating items incorporated in Project record documents concurrent with progress of the Work, including modifications, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations below first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings,(BIM Model) as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Provide a complete integrated, above ceiling submittal using the BIM model. Include ceiling, hvac, plumbing, sprinkler, lighting, cable tray, roof drains, and other components that require coordination
4. Refer instances of uncertainty to Architect for resolution.
5. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

    a. Refer to Division 01 Section "Submittal Procedures" for requirements related to use of Architect's digital data files.
    b. Architect will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.

c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file or paper copy. Verify with Architect.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file or paper copy. Verify with Architect.

1. Include record Product Data directory organized by specification section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file or paper copy. Verify with Architect.

1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment including one off-site trip for two WSU personnel.
3. Demonstration and training DVDs.

B. Related Sections:

1. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For **facilitator, instructors and videographer**.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training DVDs: Submit **FOUR** copies within **seven** days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

   a. Name of Project.
   b. Name and address of videographer.
   c. Name of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Date of video recording.

2. Transcript: Prepared on 8-1/2-by-11-inch (215-by-280-mm) paper, punched and bound in heavy-duty, three-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

   1. Inspect and discuss locations and other facilities required for instruction.
   2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
   3. Review required content of instruction.
   4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. **Program Structure**: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
   1. Equipment
   2. Fire Protection systems
   3. Elevators
   4. Heat generation equipment
   5. Refrigeration systems
   6. HVAC systems
   7. HVAC instrumentation and controls
   8. Electrical service and distribution and controls including transformers and switchboards, panelboards, and motor controls
   9. Lighting equipment and controls
   10. Communications systems including surveillance, programming voice and data.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.
      e. Equipment function.
      f. Operating characteristics.
      g. Limiting conditions.
      h. Performance curves.

   2. Documentation: Review the following items in detail:

      a. Emergency manuals.
      b. Operations manuals.
      c. Maintenance manuals.
      d. Project record documents.
      e. Identification systems.
      f. Warranties and bonds.
      g. Maintenance service agreements and similar continuing commitments.

   3. Emergencies: Include the following, as applicable:

      a. Instructions on meaning of warnings, trouble indications, and error messages.
      b. Instructions on stopping.
      c. Shutdown instructions for each type of emergency.
      d. Operating instructions for conditions outside of normal operating limits.
      e. Sequences for electric or electronic systems.

f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

   1. Schedule training with Owner**, through the General Contrractor** with at least 14 days' advance notice.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of **a demonstration** performance-based test.

E. Cleanup: Collect used and leftover educational materials and **give to Owner**. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING DVDs.

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

   1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color digital recordings with menu navigation in format acceptable to Architect.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on video recording by **audio narration by microphone while** video recording is recorded. Include description of items being viewed.

END OF SECTION 017900

SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED Silver certification based on LEED-NC, Version 3.0.

1. Other LEED prerequisites and credits needed to obtain LEED certification depend on material selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
3. A copy of the LEED Project checklist is attached at the end of this Section for information only.

B. Related Sections:

1. Divisions 01 through 33 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

1.3 DEFINITIONS

A. LEED: Leadership in Energy & Environmental Design.

B. Rapidly Renewable Materials: Materials made from plants that are typically harvested within a 10-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.

C. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles (800 km) from Project site. Manufacturing refers to the final assembly of components into the building product that is installed at Project site.

D. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials that are extracted, harvested, or recovered within a radius of 500 miles (800 km) from Project site.

E. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer).

1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.

1.4 SUBMITTALS

A. General: Submit additional LEED submittals required by other Specification Sections.

B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.

C. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:

1. Furniture.
2. Plumbing.
3. Mechanical.
4. Electrical.
5. Specialty items such as elevators and equipment.
6. Wood-based construction materials.

D. LEED Action Plans: Provide preliminary submittals within 14 days of date established for commencement of the Work indicating how the following requirements will be met:

1. Credit MR 2: Waste management plan complying with Division 01 Section "Construction Waste Management and Disposal."
2. Credit MR 4: List of materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
3. Credit MR 5 : List of regionally manufactured materials and regionally extracted and manufactured materials.

    a. Identify each regionally manufactured material, including its source and cost.
    b. Identify each regionally extracted and manufactured material, including its source and cost.
4. Credit EQ 3.1: Construction indoor-air-quality management plan.
5. Credit EQ 3.2 Option 1: Signed statement describing the building air flush-out procedures complying with Option 1 including the dates and times when the flush-out was begun and completed and statement that the filtration media was replaced after flush-out, or a signed statement indicating compliance with Option 2. Include testing data confirming compliance , showing names of contaminants and level of concentration

E. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:

1. Credit MR 2: Waste reduction progress reports complying with Division 01 Section "Construction Waste Management and Disposal."
2. Credit MR 4: Recycled content, broken down by material.

3. Credit MR 5 Regionally manufactured materials and regionally extracted and manufactured materials.
4. Credit MR 6 and Credit MR 7: Certified wood products.

F. LEED Documentation Submittals:
1. Credit MR 2.: Comply with Division 01 Section "Construction Waste Management and Disposal."
2. Credit MR 4: Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating cost(s) and weight for each product having recycled content.
3. Credit MR 5: Product data indicating location of material manufacturer for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material and for each regionally extracted and manufactured material.

   a. Include statement indicating distance from manufacturer to Project for each regionally manufactured material.
   b. Include statement indicating location of and distance from Project to point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials.
4. Credit IEQ 3.1:

   a. Construction indoor-air-quality management plan.
   b. Product data for temporary filtration media.
   c. Product data for filtration media used during occupancy.
   d. Construction Documentation: Six photographs each instance showing implemented Required IAQ practice, during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
      1. Photographs shall be taken throughout the time period when IAQ practices are required.

5. Credit IEQ 3.2:

   a. Indicate method used to comply with requirements of CR 3.2

   b. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out, if applicable.
   c. Product data for filtration media used during flush-out and during occupancy, if applicable
   d. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.

6. For IEQ Credits 4.1, 4.2 4.3 – shall be highlighted in yellow if not a part of a dedicated LEED submittal.

7. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.
8. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating chemical composition and VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.

9. Credit IEQ4.3: Product data for each carpet used. Confirm compliance with CRI Greenlabel plus. Provide a listing of each carpet cushion, where used and compliance with CRI Greenlabel plus.

1.5 QUALITY ASSURANCE

A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

PART 2 - PRODUCTS

2.1 SUSTAINABLE SITE CREDITS

A. Provide cool Roof materials complying with SS 7.2

2.2 RECYCLED CONTENT OF MATERIALS

A. Credit MR 4.: Provide building materials with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 20 percent of cost of materials used for Project.

1. Cost of post-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
2. Cost of pre-consumer recycled content of an item shall be determined by dividing weight of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
3. Do not include furniture, plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

2.3 REGIONAL MATERIALS

A. Credit MR 5: Provide a minimum of 10 percent of materials (by cost) that are regionally manufactured materials.

2.4 LOW-EMITTING MATERIALS

A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the following limits for VOC content when calculated according to SCAQMD Rule 1168 Limits to be as effective Jul1, 2005 with the list below notwithstanding:

1. Wood Glues: 30 g/L.
2. Metal to Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.

8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
20. Top and Trim Adhesive: 250 g/L.
21. Plastic Cement Welding Compounds: 350 g/L.
22. ABS Welding Compounds: 400 g/L.
23. CPVC Welding Compounds: 490 g/L.
24. PVC Welding Compounds: 510 g/L.
25. Adhesive Primer for Plastic: 650 g/L.
26. Sheet Applied Rubber Lining Adhesive: 850 g/L.
27. Aerosol Adhesive, General Purpose Mist Spray: 65 percent by weight.
28. Aerosol Adhesive, General Purpose Web Spray: 55 percent by weight.
29. Special Purpose Aerosol Adhesive (All Types): 70 percent by weight.
30. Other Adhesives: 250 g/L.
31. Architectural Sealants: 250 g/L.
32. Nonmembrane Roof Sealants: 300 g/L.
33. Single-Ply Roof Membrane Sealants: 450 g/L.
34. Other Sealants: 420 g/L.
35. Sealant Primers for Nonporous Substrates: 250 g/L.
36. Sealant Primers for Porous Substrates: 775 g/L.
37. Modified Bituminous Sealant Primers: 500 g/L.
38. Other Sealant Primers: 750 g/L.

B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content when calculated according to SCAQMD Rule 1168 and the following chemical restrictions:

1. Architectural Paints and coatings and primers applied to interior walls and ceilings shall not exceed the VOC limits established in Green Seal Standard GS-11 Paints First Edition May 1993.

1. Flat Interior Topcoat Paints: VOC not more than 50 g/L.
2. Nonflat Interior Topcoat Paints: VOC not more than 150 g/L.
3. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Clear Wood Finishes, Varnishes and Sanding Sealers: VOC not more than 350 g/L. per SCAQMD Rule 1113 effective January 1, 2004.
5. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L. Varnishes 36-g/l
6. Floor Coatings: VOC not more than 100 g/L.
7. Sealers, waterproofing sealers 260 g/l sanding sealers VOC not more than 275 g/L.
8. Dry-Fog Coatings: VOC not more than 400 g/L.
9. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
10. Pretreatment Wash Primers: VOC not more than 420 g/L.

11. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
12. Restricted Components: Paints and coatings shall not contain any of the following:

    a. Acrolein.
    b. Acrylonitrile.
    c. Antimony.
    d. Benzene.
    e. Butyl benzyl phthalate.
    f. Cadmium.
    g. Di (2-ethylhexyl) phthalate.
    h. Di-n-butyl phthalate.
    i. Di-n-octyl phthalate.
    j. 1,2-dichlorobenzene.
    k. Diethyl phthalate.
    l. Dimethyl phthalate.
    m. Ethylbenzene.
    n. Formaldehyde.
    o. Hexavalent chromium.
    p. Isophorone.
    q. Lead.
    r. Mercury.
    s. Methyl ethyl ketone.
    t. Methyl isobutyl ketone.
    u. Methylene chloride.
    v. Naphthalene.
    w. Toluene (methylbenzene).
    x. 1,1,1-trichloroethane.
    y. Vinyl chloride.

C. Credit IEQ4.3: All carpet installed in the building interior shall meet the testing and product requirements of the Carpet and Rug institute Green Label Plus Program

1. Carpet adhesive shall meet requirements of EQ4.1 with VOC limit of 50 g/L.

D. Credit IEQ 4.4: Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. Credit MR 2: Comply with Division 01 Section "Construction Waste Management and Disposal."

3.2 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Credit IEQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
2. Replace all air filters immediately prior to occupancy.

B. Credit lEQ 3.2: Comply with one of the following requirements:

1. Flush- Out
   a. After construction ends and prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000 cu. Ft of outdoor air per sq. ft, of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity not exceeding 60%
   b. If occupancy is desired prior to completion of the flush-out the space may be occupied following delivery of a minimum of 3,500 cu.ft. of outdoor air per sq.ft. of floor are to the space. Once a space is occupied it shall be ventialteed at a minimum rate of -.30 cfm/sq.ft. of outside air or the design minimum ourtside auir determined in EQ Prerequisite 1, whichever is greater. During the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy/ Theser conditions shall be maintained until a total of 14,000 cy.ft/sq.ft of outside air has been delivered to the space.

2. Air-Quality Testing:

   a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "LEED-CI: Reference Guide."
   b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:

      1) Formaldehyde: 50 ppb.
      2) Particulates (PM10): 50 micrograms/cu. m.
      3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
      4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
      5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.

   c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.
   d. Air-sample testing shall be conducted as follows:

      1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
      2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
      3) Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less

than one per 25,000 sq. ft. (2300 sq. m) or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.

4) Air samples shall be collected between 3 and 6 feet (0.9 and 1.8 m) from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

LEED – PROJECT CHECKLIST follows

END OF SECTION 018113

WSU Phase II Residential Life - Building 2
LEED Matrix: Construction Documents

CRITERIA		LEED-NC v3				STRATEGIES	
		total possible	yes	undecided	no	Intent & Requirements / LEED Criteria	Responsible person or firm
SUSTAINABLE SITES							
SSp1	**Construction Activity Pollution Prevention**	x	x			Create and Implement Erosion and Sedimentation conrol plan per EPA Construction General Permit	**GBE**
SSc1	**Site Selection**	1	1			Avoid inappropriate sites and minimize impact from building on the site	**GBE**
SSc2	**Development Density and Community Connectivity**	5	5			Channel development to urban areas with existing infrastructure	**MHTN**
SSc3	**Brownfield Redevelopment**	1			1	Rehabilitate damaged sites with environmental contamination	
SSc4.1	**Alternative Transportation: Public Trans. Access**	6	6			Reduce pollution and land-development impacts from automobile use.	**MHTN**
SSc4.2	**Alternative Transportation: Bicycle Storage**	1		1		Reduce land-development impacts from automobile use.	**WSU**
SSc4.3	**Alternative Transportation: Low-Emitting and Fuel-Efficient Vehicles**	3	3			Reduce land-development impacts from automobile use.	**WSU**
SSc4.4	**Alternative Transportation: Parking Capacity**	2	2			Reduce land-development impacts from single-occupancy vehicle use.	**MHTN**
SSc5.1	**Site Development: Protect or Restore Habitat**	1			1	Conserve existing natural areas and restore damaged areas to provide habitat	
SSc5.2	**Site Development: Maximize Open Space**	1	1			Provide high ratio of open space to development footprint to promote biodiversity	**MHTN**
SSc6.1	**Stormwater Design: Quantity Control**	1	1			Limit distruption of hydrology by reducing impervious cover, increasing on-site infiltration and managing runoff	**GBE**
SSc6.2	**Stormwater Design: Quality Control**	1	1			Reduce or eliminate water pollution by reducing impervious cover, increasing filtration, eliminating contaminants and removing pollutants from runoff	**GBE**
SSc7.1	**Heat Island Effect: Non-roof**	1			1	Reduce heat islands to minimize impact on microclimate	
SSc7.2	**Heat Island Effect: Roof**	1	1			Reduce heat islands to minimize impace on microclimate	**MTHN**
SSc8	**Light Pollution Reduction**	1			1	Minimize light trespass from building and site, reduce sky-glow to increase night sky access.	
	Sustainable Sites Subtotal	26	21	1	4		

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WSU Phase II Residential Life - Building 2
LEED Matrix: Construction Documents

CRITERIA		LEED-NC v3				STRATEGIES	
		total possible	yes	undecided	no	Intent & Requirements / LEED Criteria	Responsible person or firm
WATER EFFICIENCY							
WEp1	**Water Use Reduction: 20% Reduction**	x	x			**Required - Reduce water use by 20% (not including irrigation)**	**Colvin**
WEc1	**Water Efficient Landscaping: 50% reduction OR 100%**	4	2		2	Limit or eliminate the use of potable water for landscape irrigation	**MHTN-LS**
WEc2	**Innovative Wastewater Technologies**	2		2		Reduce generation of wastewater and potable water demand.	**Colvin**
WEc3	**Water Use Reduction: (20% Prerequisite) 30% reduction (2 points) 35% reduction (3 points) 40% reduction (4 points)**	4	4			Maximize water efficiency within buildings to reduce impact on water supply. Reduce water use by 30%, 35% or 40% (not including irrigation)	**Colvin**
	Water Efficiency Subtotal	10	6	2	2		
ENERGY & ATMOSPHERE							
EAp1	**Fundamental Commissioning**	x	x			Verify the building's energy related systems are installed, calibrated and perform according to project requirements, basis of design and CD's.	**CxA**
EAp2	**Minimum Energy Performance**	x	x			complies with ASHRAE/IESNA 90.1-2007	**ETC**
EAp3	**Fundamental Refrigerant Management**	x	x			Zero-use of CFC-based refrigerants	**Colvin**
EAc1	**Optimize Energy Performance**	19	3	4	12	Reduce design energy cost for systems regulated by ASHRAE 90.1	**ETC**
EAc2	**On-site Renewable Energy**	7		2	5	Encourage increasing level of on-site renewable energy to reduce environmental impacts associated with fossil fuel use	**Colvin**
EAc3	**Enhanced Commissioning**	2	2			Additional commissioning tasks: review SD's, CDs, & submittals, and provide recommissioning manual, review operation at 1-year.	**CxA**
EAc4	**Enhanced Refrigerant Management**	2		2		Reduce ozone depletion and support early compliance with Montreal Protocol	**Colvin**
EAc5	**Measurement & Verification**	3		3		Provide for the ongoing accountability of building energy consumption over time	**ECE**
EAc6	**Green Power**	2		2		Encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis	**MHTN**
	Energy & Atmosphere Subtotal	35	5	13	17		

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WSU Phase II Residential Life - Building 2
LEED Matrix: Construction Documents

CRITERIA		LEED-NC v3				STRATEGIES	
		total possible	yes	undecided	no	Intent & Requirements / LEED Criteria	Responsible person or firm
MATERIALS & RESOURCES							
MRp1	**Storage & Collection of Recyclables**	x	x			Facilitate the reduction of waste generated by occupants that is hauled to landfills	**MHTN**
MRc1.1	**Building Reuse: Maintain Existing Walls, Floors & Roof (55%, 75% & 95%)**	3			3	Extend life-cycle of existing building stock, conserve resources, reduce waste and environmental impacts of new buildings.	
MRc1.2	**Building Reuse: Maintain Interior non-structural elements (50% min)**	1			1	Extend life-cycle of existing building stock, conserve resources, reduce waste and environmental impacts of new buildings.	
MRc2	**Construction Waste Management (divert 50% & 75% from landfill)**	2	1	1		Divert construction and demolition debris from disposal in landfils and incinerators. Redirect recyclable recovered resources back to the manufacturing process.	**General Contractor (GC)**
MRc3	**Materials Reuse (5% & 10%)**	2			2	Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste.	
MRc4	**Recycled Content (10% & 20% post consumer + 1/2 pre-consumer)**	2	1	1		Increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction/processing virgin matls	**General Contractor (GC)**
MRc5	**Regional Materials (10% & 20% Manufactured Regionally)**	2	1	1		Increase demand for building materials and products that are regional.	**General Contractor (GC)**
MRc6	**Rapidly Renewable Materials**	1			1	Reduce the use and depletion of finite raw materials and long-cycle materials by replacing them with rapidly rewables	
MRc7	**Certified Wood**	1			1	Encourage environmentally responsible forest management	
Materials & Resources Subtotal		14	3	3	8		

3/19/2011

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WSU Phase II Residential Life - Building 2
LEED Matrix: Construction Documents

CRITERIA		LEED-NC v3				STRATEGIES	
		total possible	yes	undecided	no	Intent & Requirements / LEED Criteria	Responsible person or firm
INDOOR ENVIRONMENTAL QUALITY							
IEQp1	**Minimum IAQ Performance**	x	x			Establish minimum IAQ performance to enhance IAQ in buildings	**Colvin**
IEQp2	**Environmental Tobacco Smoke (ETS) Control**	x	x			Prohibit smoking within building and provide designated exterior smoking areas.	**MHTN**
IEQc1	**Outdoor Air Delivery Monitoring**	1	1			Provide capacity for ventilation system monitoring to help sustain occupant comfort & well being	**Colvin**
IEQc2	**Increased Ventilation**	1		1		Provide additional outdoor air ventilation to improve indoor air quality.	**Colvin**
IEQc3.1	**Construction IAQ Management Plan: During Construction**	1	1			Reduce IAQ problems resulting from construction process.	**MHTN Colvin ECE GC**
IEQc3.2	**Construction IAQ Management Plan: Before Occupancy**	1	1			Reduce IAQ problems resulting from construction process. Develop and implement an IAQ Management Plan for pre-occupancy phase as follows:	**Colvin**
IEQc4.1	**Low-Emitting Materials: Adhesives & Sealants**	1	1			Reduce the quantity of indoor contaminants	**General Contractor (GC)**
IEQc4.2	**Low-Emitting Materials: Paints and Coatings**	1	1			Reduce the quantity of indoor contaminants	**General Contractor (GC)**
IEQc4.3	**Low-Emitting Materials: Flooring Systems**	1	1			Reduce the quantity of indoor contaminants	**General Contractor (GC)**
IEQc4.4	**Low-Emitting Materials: Composite Wood & Agrifiber**	1			1	Reduce the quantity of indoor contaminants	

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WSU Phase II Residential Life - Building 2
LEED Matrix: Construction Documents

CRITERIA		LEED-NC v3				STRATEGIES	
		total possible	yes	undecided	no	Intent & Requirements / LEED Criteria	Responsible person or firm
EQc5	**Indoor Chemical & Pollutant Source Control**	1			1	Minimize exposure of occupants to potentially hazardous particulates and chemical pollutants	
IEQc6.1	**Controllability of Systems: Lighting**	1	1			Provide a high level of lighting system control by individual occupants (or groups) to promote productivity, comfort and well-being of occupants	**ECE**
IEQc6.2	**Controllability of Systems: Thermal**	1	1			Provide a high level of thermal comfort system control by individual occupants (or groups) to promote productivity, comfort and well-being of occupants	**Colvin**
IEQc7.1	**Thermal Comfort: Design**	1	1			Provide a comfortable thermal environment that supports the productivity and well-being of thhe occupants	**Colvin**
IEQc7.2	**Thermal Comfort: Verification**	1	1			Provide for the assessment of building thermal comfort over time	**Colvin**
IEQc8.1	**Daylight & Views: Daylight (75% of Spaces)**	1		1		Provide for occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into regularly occupied areas	**MHTN**
IEQc8.2	**Daylight & Views: Views (90% of Spaces)**	1		1		Provide for occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into regularly occupied areas	**MHTN**
Indoor Environmental Quality Subtotal		15	10	3	2		

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WSU Phase II Residential Life - Building 2
LEED Matrix: Construction Documents

CRITERIA		LEED-NC v3				STRATEGIES	
		total possible	yes	undecided	no	Intent & Requirements / LEED Criteria	Responsible person or firm
INNOVATION IN DESIGN							
ID c1.1	**Innovation Credit 1**	1	1			Education plan	**MHTN**
ID c1.2	**Innovation Credit 2**	1	1			Green Housekeeping	**MHTN GC**
ID c1.3	**Innovation Credit 3**	1		1		Exemplary performance interior water reduction	**Colvin**
ID c1.4	**Innovation Credit 4**	1		1		Motion sensors at interior lighting	**ECE**
ID c1.5	**Innovation Credit 5**	1		1		Motion sensors at exterior lighting	**ECE**
ID c2	**LEED Accredited Professional**	1	1				**MHTN**
	Innovation Subtotal	6	3	3	0		
REGIONAL PRIORITY							
RBc1.1	**Regional Bonus Credit 1**	1	1			SSc2 Community Connectivity	**MHTN**
RBc1.2	**Regional Bonus Credit 2**	1	1			SSc4.1 Alternative Transportation - Public Transportation	**MHTN**
RBc1.3	**Regional Bonus Credit 3**	1		1		EAc1 Optimize Energy Performance (36%/32%)	**ETC**
RBc1.4	**Regional Bonus Credit 4**	1		1		IEQc8.1 Daylight & Views: Daylight (75% of Spaces)	**MHTN**
	Regional Priority Subtotal	4	2	2	0		
	PROJECT TOTALS	**110**	**50**	**27**	**33**		
40	Certified						
50	Silver		X				
60	Gold						
80	Platinum						

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SECTION 019100 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. OPR and BoD documentation

1.2 SUMMARY

A. Prepared by Owner and Architect contains requirements that apply to this Section.

B. This Section includes:

1. General requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.
2. Commissioning Team
3. Commissioning Meetings
4. Construction Checklist Overview
5. Controls Verification
6. Functional Performance Testing
7. Training Development
8. Commissioning Plan

C. Related Sections
1. Division 01 Section “Sustainable Design Requirements” for specific requirements related to LEED Project Requirements.
2. Division 01 Section “Construction Waste Management and Disposal”
3. Division 01 Section "HVAC Systems Commissioning requirements" for specific requirements for commissioning HVAC systems.
4. Division 01 Section "Electrical Systems Commissioning Requirements" for specific requirements for commissioning Electrical Systems.

1.3 DEFINITIONS

A. BoD: Basis of Design.

B. CxA: Commissioning Authority.

C. OPR: Owner's Project Requirements.

D. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

E. TAB: Testing, Adjusting, and Balancing.

1.4 DESCRIPTION

A. The owner has elected to use the Commissioning Process as part of their quality process to plan, design, construct and operate this building.

1. As with any quality process, Commissioning provides tools to enable everyone involved in the construction of a building to ensure that the final building meets the original intent of the Owner.
2. A primary tool used is the completion of construction checklists by individual workers. The checklists are simple to fill out and easily track the current state of work by providing the key criteria in the specifications the Owner has defined as important for the successful installation and long-term operation of systems and equipment.

B. A key component of Commissioning is the verification of the operation of systems, including electrical, plumbing, and heating and cooling systems in all modes of operation to ensure the building is ready for year-round occupancy.

C. Commissioning provides focused training of operation and maintenance personnel by ensuring that detailed training agendas are utilized and requiring detailed submittal requirements from Contractors prior to accomplishing any training.

D. The owner is financially responsible for contracting the services of the CxA to perform the CxA duties as specified in this section.

E. The contractor is responsible to deliver a quality, functionally complete system as specified in the project documents. In the event that the contractor has certified that systems are complete and functional, and then the systems fail inspection or verification, the contractor will be financially responsible for the additional services of the CxA to retest equipment.

F. Systems to be commissioned:

1. Electrical:
   a. Normal Power Systems
   b. Emergency Power
   c. Lighting Control Systems
   d. Daylight Dimming Control Systems

2. Mechanical Systems:
   a. Building HVAC Systems and Controls
   b. Plumbing Systems

1.5 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions.
2. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:
   1. CxA: Utah New Vision Construction LLC is the designated company that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner has engaged the CxA under a separate contract.
   2. Representatives of the Owner's facility user and operation and maintenance personnel.
   3. Architect and engineering design professionals.

1.6 ARCHITECT RESPONSIBILITIES

A. For 50% design, CD, and completed conformance, provide one half size paper set of project drawings and one bound set of specifications. Also provide one CD with the electronic copy of both drawings and specifications in searchable PDF format.

1.7 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and Contractor for use in developing the commissioning plan; systems manual; operation and maintenance training plan; and testing plans and checklists.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to the following:
   1. Training in operation and maintenance of systems, subsystems, and equipment.
   2. On-Site Inspections
   3. Demonstration of operation of systems, subsystems, and equipment.

C. Provide the BoD documents, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.8 CONTRACTOR'S RESPONSIBILITIES

A. Coordinate this Article with requirements specified in Division 01 Section "Multiple Contract Summary" for Project Coordinator's responsibilities.

B. Provide utility services required for the commissioning process.

C. Contractor shall assign representatives with expertise and authority to act on behalf of the Contractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
   1. Participate in design- and construction-phase coordination meetings.
   2. Integrate all commissioning activities into the master schedule.
   3. Participate in maintenance orientation and inspection.
   4. Participate in operation and maintenance training sessions.
   5. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
   6. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
   7. Review and approve final commissioning documentation.
   8. Participate in the Ten-Month Review as required by LEED

D. Subcontractors shall assign representatives with expertise and authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in design- and construction-phase coordination meetings.
2. Participate in maintenance orientation and inspection.
3. Provide scheduling input to the Contractor.
4. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.
5. Provide information to the CxA for developing construction-phase commissioning plan.
6. Participate in training sessions for Owner's operation and maintenance personnel.
7. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CxA, as specified in Division 01 Section "Operation and Maintenance Data."
8. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems, and equipment.
9. Participate in the Ten-Month Review as required by LEED

1.9 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Prepare a construction-phase commissioning plan. Collaborate with Contractor and with subcontractors to develop test and inspection procedures. Include design changes and scheduled commissioning activities coordinated with overall Project schedule. Identify commissioning team member responsibilities, by name, firm, and trade specialty, for performance of each commissioning task.

C. Review and comment on submittals from Contractor for compliance with the OPR, BoD, Contract Documents, and construction-phase commissioning plan. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the OPR and BoD.

D. At the beginning of the construction phase, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; and Project completion.

E. Observe and inspect construction and report progress and deficiencies. In addition to compliance with the OPR, BoD, and Contract Documents, inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.

F. Prepare Project-specific test and inspection procedures and checklists.

G. Develop an enhanced start-up and initial systems checkout plan with Subs.

H. Schedule, direct, witness, and document tests, inspections, and systems startup.

I. Compile test data, inspection reports, and certificates and include them in the commissioning report.

J. Review Project Record Documents for accuracy. Request revisions from Contractor to achieve accuracy. Project Record Documents requirements are specified in Division 01 Section "Project Record Documents."

K. Review and comment on operation and maintenance documentation for compliance with the OPR, BoD, and Contract Documents. Operation and maintenance documentation requirements are specified in Division 01 Section "Operation and Maintenance Data."

L. Prepare operation and maintenance training program and provide qualified instructors to conduct operation and maintenance training. Operation and maintenance training is specified in Division 01 Section "Demonstration and Training."

M. Prepare commissioning report.

N. Prepare and submit LEED documentation

1.10 COMMISSIONING DOCUMENTATION

A. OPR: A written document, prepared by Owner, that details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

B. BoD Document: A document, prepared by Architect, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

C. Commissioning Plan: A document, prepared by CxA, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:

1. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
2. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
3. Description of responsibilities of commissioning team members.
4. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
5. Communications channels that will be used during the commissioning process.
6. Identification of systems and equipment to be commissioned.

D. Test Checklists:

1. CxA, with assistance of Architect/Engineers, shall:
   a. Develop test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested.
   b. Prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Provide space for testing personnel to sign off on each checklist. Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

a) Name and nomenclature of tested item.
b) Indication of whether the record is for a first test or retest following correction of a problem or issue.
c) Dated signatures of the person performing test and of the witness, if applicable.
d) Individuals present for test.
e) Deficiencies.

2. Contractor, Subcontractor(s), and Installer(s) shall,
   a. Provide on-site startup reports by factory representative where required in the specification.
   b. Provide Certificate of Readiness: Certificate of Readiness shall be signed certifying that systems, subsystems, equipment, and associated controls are ready for testing. Completed test checklists signed by the responsible parties shall accompany this certificate.

E. Test and Inspection Reports:

1. CxA shall record test data, observations, and measurements on test checklists. Photographs, forms, and other means appropriate for the application shall be included with data.
2. CxA shall compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

F. Corrective Action Documents:

1. CxA shall document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any.
2. Retest systems and equipment requiring corrective action and document retest results.

G. Commissioning Report:

1. CxA shall document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment.
2. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the OPR, BoD, and Contract Documents.
3. The commissioning report shall include, but is not limited to, the following:
   a. Lists and explanations of substitutions; compromises; variances in the OPR, BoD, and Contract Documents; record of conditions; and, if appropriate, recommendations for resolution.
   b. This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during Owner occupancy and operation.
   c. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.
   d. OPR and BoD documentation.
   e. Commissioning plan.
   f. Project Correspondence
   g. Completed test checklists.

H. LEED Documentation:

1. EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems

a. Completed Owner's Project Requirements (OPR) and Basis of Design (BOD) documentation.
b. Incorporated Commissioning requirements into construction documents.
c. Developed and utilized a commissioning plan.
d. Verified installation and performance of commissioned systems.
e. Completed Commissioning Report.

2. EA Credit 3: Enhanced Commissioning
Verify the following:
a. The CxA has conducted at least one Commissioning Design Review of the Owner's Project Requirements (OPR), Basis of Design (BOD), and design documents prior to mid-construction documents phase and back-check the review comments following design submission.
b. The CxA has reviewed contractor submittals applicable to systems being commissioned for compliance with the OPR and BOD.
c. A systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems has been prepared for the project.
d. The operating personnel and building occupants have been trained in the operation and maintenance of the commissioned systems.
e. The CxA will review building operation within 10 months after substantial completion, and a plan for resolution of outstanding issues has been completed.

I. Listing of off-season test(s) not performed and a schedule for their completion.

1.11 SUBMITTALS

A. Commissioning Plan Preliminary Submittal:

1. CxA shall submit three hard copies of preliminary commissioning plan. Deliver one copy to Contractor, one to Owner, and one to Architect.
2. Present submittal in sufficient detail to evaluate data collection and arrangement process. One copy, with review comments, will be returned to the CxA for preparation of the final construction-phase commissioning plan.

B. Commissioning Plan Final Submittal:

1. CxA shall submit two hard copies and two sets of electronically formatted information of final commissioning plan.
2. Deliver one hard copy and one set of discs to Architect. The final submittal must address previous review comments. The final submittal shall include a copy of the preliminary submittal review comments along with a response to each item.

C. Test Checklists and Report Forms:

1. CxA shall submit sample checklists and forms to Contractor quality-control manager and subcontractors for review and comment.
2. Submit two copies of each checklist and report form.

D. Test and Inspection Reports: CxA shall submit test and inspection reports.

E. Commissioning Report Submittal:

1. CxA shall submit two hard copies and two sets of electronically formatted information of the final commissioning report.
2. CxA shall deliver one hard copy and one set of discs to Architect.

F. LEED Documentation Submittal:

1. Upload the required LEED documentation to the U.S. Green Building Council (USGBC) web site.

1.12 COORDINATION

A. Testing Coordination: CxA shall coordinate sequence of testing activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting and schedule times for tests, inspections, obtaining samples, and similar activities.

B. Manufacturers' Field Services: Contractor shall coordinate services of manufacturers' field services personnel.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Standard Testing Equipment: All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. For example, themechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipments for the HVAC system and controls system in Division 23, except for equipment specific to and used by TAB in their commissioning responsibilities. Two-way radios shall be provided by the Division Contractor as needed and as directed by the CxA.

B. Special Equipment: Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone datalogging equipment that may be used by the CA.

C. Data Logging Equipment: Data Logging equipment, software and services required to test equipment will be provided by the contractor, but shall not become the property of the Owner.

D. Equipment Quality: All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

A. Training Preparation Conference:

1. Before operation and maintenance training, CxA shall convene a training preparation conference to include Owner's operation and maintenance personnel, Contractor, and subcontractors.

B. Training Modules:

1. An instruction program that includes individual training modules for each system, subsystem, and equipment as specified in Division 01 Section "Demonstration and Training" will be developed
2. Each module shall be developed according to the format established for this project, by the individuals responsible for that system or component.

3.2 DEFERRED TESTING

A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy or other deficiency, execution of checklists and functional testing may be delayed upon approval of the Contractor. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builds due to the testing will be made by the contractor.

END OF SECTION 019100

SECTION 01 91 25– BUILDING ENCLOSURE COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

A. The design intent of the building enclosure is to provide exterior floor, wall, and roof assemblies which prevent uncontrolled air and water infiltration and include products and assemblies that are technically sound, durable and serviceable. This section includes requirements for non-structural commissioning of the building enclosure, including, but not limited to the following:

1. Above-grade construction, including: exterior wall materials and assemblies; low-slope roofing, glazed windows, curtain wall and glazing systems.
2. Interface conditions (flashings, expansion joints, sealant) between each of the materials, components and systems that comprise the above and below-grade building exterior enclosure.
3. The air/weather barrier system will receive detailed attention on the mock-up and be tested for compliance within testing protocol.

B. The purpose of the building enclosure commissioning (BECx) is to provide a process for independent, third-party verification that the installed performance of the building enclosure meets or exceeds the minimum performance requirements set forth by the Contract Documents for this project. The materials, components, systems, and assemblies that comprise the above and below-grade building exterior enclosure will be evaluated and tested as outlined in this Section, as well as in accordance with each of the technical Sections associated with the design and construction of the building enclosure.

C. The General Contractor is to construct the testable Exterior Enclosure mock-up as detailed, all materials and systems to match the building construction. The mock-up must be completed, all testing procedures passed and fully accepted before beginning installation of sheathing on the building.

1.2 RELATED DOCUMENTS AND SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 and Technical Specification Sections, apply to this Section.

1. Division 1 Section “Commissioning Plan & Specification”
2. Division 1 Section “Sustainable Design Requirements” for specific requirements related to LEED Project Requirements.
3. Division 4 Section “Unit Masonry Assemblies”
4. Division 4 Section “Dimension Stone Cladding”
5. Division 6 Section “Panel Sheathing”
6. Division 6 Section “Fiberglass Reinforced Paneling”
7. Division 7 Section “Self-Adhering Sheet Waterproofing”
8. Division 7 Section “Thermal Insulation”
9. Division 7 Section “Fluid Applied Membrane Air Barriers”
10. Division 7 Section “Composite Metal Wall Systems”
11. Division 7 Section “Thermoplastic Membrane Roofing”
12. Division 7 Section “Sheet Metal Flashing and Trim”
13. Division 7 Section “Joint Sealants”
14. Division 8 Section “Steel Doors and Frames”
15. Division 8 Section “Aluminum Entrances and Storefronts”
16. Division 8 Section “Glazed Aluminum Curtain Walls”
17. Division 8 Section “Aluminum Windows”
18. Division 8 Section “Glass and Glazing”
19. Division 9 Section “Gypsum Board Assemblies”

20. Division 10 Section "Exterior Sun Control Devices"

1.3 REFERENCE STANDARDS

A. ASHRAE NIBS Guideline 3 "Exterior Enclosure Technical Requirements for the Commissioning Process"

B. U.S. Army Corps of Engineers "Air Leakage Test Protocol for Measuring Air Leakage in Buildings"

C. ASTM E779 "Standard Test Method for Determining Air Leakage Rate by Fan Pressurization"

D. ASTM E783 "Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors"

E. ASTM E1105 "Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference"

F. ASTM E1186 "Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems"

G. ASTM E1827 "Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door"

1.4 DEFINITIONS AND ABBREVIATIONS

A. Architect: Architect-of-Record for this project

B. Building Enclosure: The physical separator between the interior and exterior environments of a building. Typical building enclosure components include the base floor systems, below-grade wall systems, above-grade wall systems (including windows and doors), and the roof systems.

C. Building Enclosure Commissioning (BECx): The process of inspecting andtesting building components and assemblies to ensurethe installed performance of the building enclosure meets or exceeds the minimum performance requirements set forth by the Contract Documents.

D. Building Enclosure Commissioning Agent (BECxA): The Party retained by the Commissioning Agentwhich will manage the BECx process, develop and stipulate the BECx requirements, and validate that the components and assemblies are designed, constructed, and tested to meet requirements set forth in the in the Contract Documents.

E. Building Enclosure Commissioning Plan (BECxP): Project-specific protocol developed by the BECxA, whichoutlines the BECx process for all related components and assemblies. This document will identify the Commissioning Team and include comprehensive checklists and general schedule of all tasks involved in the BECx, including design reviews, construction observations, mockup construction and testing, whole building air leakage testing, and technical reports that will be produced over the course of the Project.

F. Building Enclosure Commissioning Report: The final deliverable from the BECx process, this document includes a full summary report withappropriate documentation including the following information: a narrative describing the BECx items and issues found, a summary and list of enclosure systems and components included in the commissioning program, a description of non-compliant conditions noted during site observations with follow up documentation on the means and methods to resolve, and summary results of building performance testing.

G. Building Enclosure Commissioning Team: Owner and his consultants, Contractor, Architect, Commissioning Authority, Building Enclosure Commissioning Agent.

H. Commissioning Agent (CxA): The Party responsible for coordinating and carrying out the entire scope of the commissioning process. The Commissioning Agent collaborates with the BECxA to accomplish the building enclosure commissioning.

I. Contract Documents: Documents governing the responsibilities and relationships between Parties involved in the design and construction of this project, including (but not limited to): Agreements/Contracts, Drawings and Specifications, Addenda, Change Orders, BECx Plan (for reference only).

J. Construction Documents: Refers to the Contract Documents that dictate the details of construction.

K. Contractor: As used herein, 'Contractor' is a general reference to the installing Party and can therefore refer to the General Contractor, Project Manager, subcontractors, or vendors as inferred by its usage.

1.5 BUILDING ENCLOSURE COMMISSIONING AGENT REQUIREMENTS

A. Current registered Professional Engineer,Licensed / Registered Architect, or a commissioning entity (Commissioning Authority)certified by The Building Commissioning Association (BCA) or AABC Commissioning Group (ACG).

B. A minimum8years of experience in the practices that encompass BECx-related consulting services, including all of the following:

1. Performing architectural drawing and specification design peer reviews.
2. Evaluating submittal compliance.
3. Administering pre-design and pre-construction meetings.
4. Performing/supervising relevant field performance and diagnostic testing.
5. Evaluating as-built component/assembly compliance.
6. Performing forensic evaluations of as-built construction.

C. Aminimum 8 yearsof direct experience in the commissioning of building envelope systems, with a minimum of 3 projects totaling over 100,000 sq. ft. in size. Experience must include performing/supervising all field performance and diagnostic tests referenced in Part 3 of this Specification Section.

D. Level I Certified Infrared Thermographer designation or greater by anationally accredited certification institution.

1.6 BUILDING ENCLOSURE COMMISSIONING AGENT SCOPE OF SERVICES / RESPONSIBILITIES

A. CxA will engage a qualified BECxA to perform all consulting services, including design reviews, collaborative meetings, quality assurance observations, and field testing, unless specified otherwise.

B. Prior to commencement of construction, develop a Building Envelope Commissioning Plan (BECxP) for this project, which outlines the BECx process for all related components and assemblies. This document will identify the Commissioning Team and include a comprehensive checklist and general schedule of all tasks involved in the BECx, with responsibilities assigned, including planning meetings, design reviews, construction observations, mockup construction and testing, fenestration testing, and whole building air leakage testing, and technical reports that will be produced over the course of the Project.

C. During construction phase, deliverables to the CxA and Owner will includethe following:

1. Photograph-based quality assurance reports
2. Technical memoranda
3. Written recommendations for proposed solutions of deficiencies noted

4. Checklists, completed by the Contractor, with annotation of deficiencies
5. Submittals for all field testing to be performed
6. Comprehensive technical reports for all field testing performed and witnessed

D. Review project drawings and specifications at 50-percent and 100-percent design complete for constructability and conformance with respect to air, water, and vapor barriers of the exterior building enclosure. Prepare a written report along with redlined drawing sheets.

E. Review and comment on submittals from the Contractor for compliance with the building enclosure requirements set forth in the Contract Documents. Note that the BECxA does not have the authority to accept or reject submittals.

F. Schedulea pre-construction commissioning conference prior to start of the construction of the building enclosure, at a time convenient to the Owner, Contractor, and Architect. The BECxA will conduct the meeting to review commissioning responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, all Contractors whose work is relevant to the building enclosure, Commissioning Agent, Architect, and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to commissioning.
2. Agenda: Discuss items of significance that could affect progress including the following:
   a. Building Enclosure Commissioning Plan and related specifications
   b. Tentative construction schedule per Contractor
   c. Phasing
   d. Critical work sequencing
   e. Designation of key personnel and their duties
   f. Mockup construction and testing
   g. Procedures for testing and inspecting
   h. Submittal procedures
   i. LEED requirements
   j. Preparation of record documents
   k. The process for correcting deficient work
   l. Maintenance requirements to maintain enclosure

G. Observe construction of building enclosure work and report progress and deficiencies. Provide a report of each site visit, including a list of observed deficiencies and discrepancies, to CxA,Owner and General Contractor.

H. Facilitate and perform mock-up field testing of exterior building envelope components and assemblies, as required by the Contract Documents. Document construction of commissioned components at the completion of mock-up testing and provide a technical report with this information to CxA and Owner.

I. Participate (in person if conducted duringBECxA observation of building enclosure work, or remotely if not) in periodic BECx meetings to review and discuss issues and concerns related to the building envelope noted by the Architect of Record, the CxA, BECxA, and the Owner.

J. Facilitate and perform field tests identified to be accomplished by the “Testing Agency” in the Sections identified in Part 3.

K. After all air barrier components are installed, facilitate and perform whole building air tightness testing in accordance with Specification Section 072726. Testing shall consist of both performance and diagnostic evaluations. Document test results and provide to the CxA and Owner.

L. Provide a Building Enclosure Systems Manual to the BECxA as part of the project record closeout. This Systems Manual includes the following items, as related to the building enclosure:

1. Identification of installed exterior enclosure components, assemblies, systems, and equipment.
2. Certificate of completion, certifying that exterior enclosure assemblies, systems, equipment and associated controls are complete and ready for testing.
3. As-built drawings, including a copy of all details and drawings that were installed as part of any addendums or change orders directives.
4. Project specifications, including all accepted product substitutions and any additional specifications as part of addendums or change order directives.
5. A copy of all accepted change orders.
6. A copy of all shop drawings with the Architect's mark-ups, showing the as-built conditions.
7. A copy of all warranties, organized by product, and all product manufacturer's letters indicating the product as appropriate to the use for the application installed at this project.
8. A master product list summarizing all products used on the project for construction of the building enclosure, organized by tabs in a binder, including the following:
   a. Product name
   b. Product manufacturer
   c. Catalog or other applicable number for ordering
   d. Manufacturer's contact information, including the contact information for the technical representatives
   e. Product color
   f. Supplier contact information
   g. Product installation instructions, including instructions supplied with any of the shop drawings
   h. Manufacturer's product maintenance guide
   i. Manufacturer's checklist for periodic review/maintenance plan

M. The Building Enclosure Systems Manual shall be developed for each major building exterior enclosure system including, but not limited to:

1. Roof systems (including parapets, penetrations, curbs, etc.)
2. Skylights/sloped glazing
3. Exterior wall systems (all types)
4. Windows
5. Doors
6. Sealants
7. Building expansion joint accessories (roof and wall)
8. Flashings
9. Shading devices
10. Curtain walls/window walls, storefronts
11. Below-grade waterproofing
12. Planters and planted areas adjacent to building enclosure
13. Floors (slab-on-grade, crawlspace, etc.)
14. Any other special building enclosure system, equipment and controls.

N. Conduct a maintenance and training orientation meeting/inspection with Contractor, CxA, Owner's representative, and building operations and maintenance staff. Review the Building Enclosure Systems Manual to ensure all parties understand expected performance levels and maintenance requirements of building enclosure components.

O. Prepare BECxReport and deliver to CxA and Owner.

P. Prepare and submit LEED documentation, if required in 018113 Sustainable Design Requirements, for an Innovation in Design Credit for BECx.

Q. Building Enclosure Commissioning Agent is not authorized to:

1. Release, revoke, alter or expand requirements of Contract Documents
2. Approve or accept any portion of the work
3. Revise construction drawings and specifications
4. Perform any duties of the Contractor

1.7 CONTRACTOR RESPONSIBILITIES

A. Furnish copies of all submittals, shop drawings, manufacturer's literature, installation instructions, maintenance information, schedules, warranties, or other information as requested. Note that it is the Architect and Contractor's responsibility to approve or reject submittals and shop drawings.

B. Provide access to work, including scissor /boom lifts and/or scaffolding and coordinate scheduling with the BECxA to perform BECx tasks.

C. Provide qualified personnel for assistance in completing the commissioning tests for elements of the building envelope.

D. Construct negative pressure test chambers, as directed by the BECxA, used to accomplish ASTM E783 and E1105 field testing in Division 07 and 08.

E. Provide a power and water source for completing the commissioning tests for elements of the building envelope.

F. Submit a copy of the General Contractor's project and site specific Quality Assurance program to be implemented for construction for review prior to beginning of construction.

G. Participate and ensure all subcontractors utilized for work on the building enclosure participate in the Preconstruction Meeting with the design and construction teams, Owner's representatives, CxA and BECxA.

H. Complete and participate in the construction of on-site mock-ups including elements of the building exterior enclosure, as identified in individual sections of the specifications in Divisions 2 through 9.

I. Provide personnel to be present and have a representative present from each trade and/or subcontractor associated with installing the systems during mock-up performance testing. Personnel who are to be completing work in the field are to be utilized to participate in the construction of on-site mockups of building enclosure assemblies as required by the Construction Documents, and to have a representative present during inspection and testing of mockups. If deficiencies are observed within the mockup, provide labor and materials to repair or reconstruct the mockup such that deficiencies do not exist and mockup passes field testing.

J. Schedule and conductperiodic BECx meetings with a representative present from each trade and/ or subcontractor to review and discuss issues and concerns related to the building envelope noted by the Architect of Record, the CxA, BECxA, and the Owner and what action will be taken to address the noted non-conformances. Maintain a summary of non-conformances and current status.

K. Reimburse Owner for additional testing and inspections if building enclosure systems and mockups are not constructed per Construction Documents.

L. Prepare the building envelope to be in the "Closed" position as identified in Specification 072726 and as directed by the BECxA for whole building Air Barrier Testing.

M. If the building fails the Air Barrier Test specified in 072726, BECxA will perform diagnostics to identify deficiencies and sources of air leakage. Trades related to deficiencies shall provide labor and materials to adequately repair these areas.

1.8 ARCHITECT RESPONSIBILITIES

A. Provide paper and electronic copies of project drawings and specifications to the BECxA.

1. Clearly illustrate the continuous air barrier boundary on additional plan and section sheets, as required. Boundary to include integrated floor/slab, walls, and roof/ceiling assemblies.
2. Clearly define air barrier materials and assemblies for each component on drawings and in related specifications. Specified air barrier materials and assemblies should meet the requirements set forth in applicable Divisions of the Specification.
3. Provide details illustrating integration of air barrier materials at all transitions (e.g., roof-to-wall, wall-to-floor, building expansion joints, exterior doors and windows, etc.).

B. Provide written responses to design review comments from the CxA or other parties as requested.
C. Attend pre-construction commissioning conference.
D. Perform submittal review, construction observation, as-built drawing preparation, etc. as contracted.
E. Coordinate resolution of system deficiencies identified during BECx according to contract documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

A. Systems to be commissioned: Refer to the Related Documents and Sections identified in 1.2 for specific requirements. The systems and elements to be commissioned include:
1. Roof systems (including parapets, penetrations, curbs, etc.)
2. Exterior wall systems (all types), including air/weather barrier
3. Windows
4. Doors
5. Sealants
6. Building expansion joint accessories (roof and wall)
7. Flashings
8. Shading devices
9. Curtain walls/window walls, storefronts
10. Any other special building enclosure system, equipment and controls.

B. Contractors shall provide sufficient notice to theBECxA regarding their completion schedule for the mockup assemblies or envelope.

C. Mockup Testing Requirements

1. Mockup tests will be performed by the BECxA per Contract Documents in order to verify component and assembly performance prior to commencing with construction and during the initial phases of construction.
2. Contractors shall provide sufficient notice to the BECxA regarding their completion schedule for the mockup assemblies or exterior enclosure systems. The BECxA will schedule field testing through the Contractor and CxA.
3. If mockups do not pass initial testing, Contractor shall provide labor and materials to repair mockup until a successful test is achieved.

D. Test Methods

1. The test methods listed below are included as reference to their respective Specification Sections. This is a summary of the field tests required by the Construction Documents.

2. Section 074243 - COMPOSITE METAL WALL PANEL SYSTEMS
   a. Construct mockup in the location and of the size as directed by the Architect
   b. Test mockup in accordance with ASTM E1105 as specified in this Section.
3. Section 084113 - ALUMINUM ENTRANCES AND STOREFRONTS
   a. Construct mockup in the location and of the size as directed by the Architect.
   b. Test mockup (stand-alone or installed) in accordance with ASTM E783 to the requirements set forth in the related specification section.
   c. Test mockup (stand-alone or installed) in accordance with ASTM E1105 to the requirements set forth in the related specification section.
4. Section 084413 – GLAZED ALUMINUM CURTAIN WALLS
   a. Construct mockup in the location and of the size as directed by the Architect.
   b. Test mockup (stand-alone or installed) in accordance with ASTM E783 to the requirements set forth in the related specification section.
   c. Test mockup (stand-alone or installed) in accordance with ASTM E1105 to the requirements set forth in the related specification section.
5. Section 085113 – ALUMINUM WINDOWS
   a. Construct mockup in the location and of the size as directed by the Architect.
   b. Test mockup in accordance with ASTM E783 to the requirements set forth in the related specification section.
   c. Test mockup in accordance with ASTM E1105 to the requirements set forth in the related specification section.
6. Specification 014525 – WHOLE BUILDING AIR BARRIER TESTING
   a. After all air barrier components have been installed, conduct whole building air barrier testing.
   b. Test building in accordance with the USACE Air Leakage Test Protocol for Measuring Air Leakage in Buildings. Accomplish both performance testing and diagnostic evaluation, as described in the USACE Protocol.

END OF SECTION 01 91 25

SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of the existing building Wasatch Hall, utilities and **site improvements as shown**.
2. **Removing** below-grade construction.
3. Disconnecting, capping or sealing, site utilities.
4. Salvaging items will be completed by owner prior to start of demolition.

B. Related Sections include the following:

1. Division 01 Section "Summary" for use of the premises and phasing requirements.
2. Division 01 Section **Photographic Documentation**" for preconstruction photographs taken before building demolition.
3. Division 01 Section "Temporary Facilities and Controls" for temporary construction, protection facilities, and environmental-protection measures for building demolition operations.
4. Division 01 Section "Construction Waste Management and Disposal" for recycling and disposal of nonhazardous demolition wastes and for removal and storage of refrigerant
5. Division 2 Section for Site Demolition.
6. Division 26 Sections for demolishing and/or relocating site electrical items.
7. Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.3 DEFINITIONS

A. Demolish: Completely remove and legally dispose of off-site.

B. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

C. Items removed by Owner prior to start of work:

All pumps and motors from boiler room
Burner unit from the boiler and associated controls
All pneumatic controls from the boiler room
Air compressor from the boiler room
Toilets approximately 4 units
Bathroom sinks approximately 4 units
Kitchen faucets
Heater motors from the individual apartments approximately 8
All lock sets from apartment doors
Window blinds from each apartment
Fire system equipment components

D. Any items left on premises including furniture construction materials become the property of the Contractor and are to be removed from site.

1.5 SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit informational report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and for noise control. Indicate proposed locations and construction of barriers.

1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain.

C. Schedule of Building Demolition Activities: Indicate the following:

1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Temporary interruption of utility services.
3. Shutoff and capping or re-routing of utility services.

D. Predemolition **Photographs or Video**: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by building demolition operations. Comply with Division 01 Section "Photographic Documentation." Submit before the Work begins.

E. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to building demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be demolished.
2. Review structural load limitations of existing structures.
3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review and finalize protection requirements.
5. Review procedures for noise and dust control.
6. Review procedures for protection of adjacent buildings.
7. Review items to be salvaged and returned to Owner.

1.7 PROJECT CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.

1. Provide not less than **72** hours' notice of activities that will affect operations of adjacent occupied buildings.
2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Owner assumes no responsibility for buildings and structures to be demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. Hazardous Materials: Hazardous materials abatement will be completed by Owner

E. On-site storage or sale of removed items or materials is not permitted.

F. Explosives: Use of explosives is not permitted.

1.8 COORDINATION

A. Arrange demolition schedule so as not to interfere with operations of adjacent occupied buildings.

PART 2 - PRODUCTS (Not Used)

2.1 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Geotechnical Report.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped or re-routed before starting demolition operations.

B. Review Project Record Documents of existing construction provided by Owner, if available. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.2 PREPARATION

A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.

B. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.

1. Owner will arrange to shut off indicated utilities when requested by Contractor.
2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
3. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.

C. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of demolition.

3.3 PROTECTION

A. Existing Facilities: Protect adjacent walkways and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

a. Schedule disruptions in service for weekends and provide at least **72** hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, and canopies where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 01 Section "Temporary Facilities and Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.4 DEMOLITION, GENERAL

A. General: Demolish indicated existing buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain fire watch during and for at least Four hours after flame cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Engineering Surveys: During demolition, perform surveys to detect hazards that may result from building demolition activities.

C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations and DFCM requirements. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

D. Explosives: Use of explosives is not permitted.

3.5 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feet (1.5 m) minimum outside footprint indicated for new construction. Abandon below-grade construction outside this area.

1. Remove below-grade construction, including basements, foundation walls, and footings, **completely**.

D. Existing Utilities: Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.

1. For any existing utility tunnels encountered, partially remove existing that interferes with new phases of the work.

2. Protect structures that remain and repair as indicated in other sections.

3.6 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Backfill site to align with adjacent grades, sloped to drain away from adjacent structures.

3.7 REPAIRS

A. Promptly repair damage to adjacent buildings, pavements, site amenities, etc. caused by demolition operations.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site. See Division 01 Section "Construction Waste Management and Disposal" for recycling and disposal of demolition waste.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.9 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024116

SECTION 024117 - HAZARDOUS MATERIAL ABATEMENT

The work of this Section is provided by the Owner to incorporate into the General Construction Contract and is provided for information to Bidders

Scope of Work: **Wasatch Hall Building, Ogden**, Utah,

1. Interior Wall Removal During Demolition

   A. Contractor shall remove all walls containing "block filler" and associated adhesive from the building with the demolition debris. The block filler contains **up to 25% chrysotile** asbestos; this material is bound up in the paint which was applied to the block throughout the inside of the building. There is approximately **32,000 square feet** of currently **non-friable** block filler to be removed. Contractor shall wet the material prior to and as it is removed and shall place it in poly-lined dumpsters prior to transport. Block filler is considered a Category 1 non-friable material according to Utah DAQ (Utah Air Quality Rules, R-307-801. Asbestos); OSHA considers this a Class 2 operation (29 CFR 1926.1101).

   B. Contractor shall exercise due care and caution to avoid unnecessary dust during the demolition. Industrial hygiene personnel will be collecting daily air samples in the area of the demolition (upwind and downwind) and will stop or slow the work as necessary to ensure dust remains at an acceptable level. Air samples will be analyzed to determine if more extensive dust control procedures will be necessary (such as wetting the block with encapsulant prior to demolition). Small-scale interior demolition of this material has shown no significant elevation of airborne asbestos levels; elevated levels during demolition is not expected.

   C. Contractor shall ensure equipment operators are trained as per OSHA requirements prior to working on the site. This training shall last at least 5 hours.

   D. Contractor shall perform asbestos air sampling (TWA and EL) for his workers to guarantee adequate respiratory protection is utilized during the work. Sampling shall be performed daily during the project.

   E. Contractor shall ensure each load of debris from the site is in leak-tight containers. Contractor shall line his dumpsters with heavy duty poly sheeting and enclose the load in a leak-tight manner prior to transport.

   F. Contractor shall ensure this waste is approved by the intended landfill prior to transport. Contractor shall include all applicable landfill fees associated with this waste in his bid.

2. Underground Storage Tank Removal

   A. Contractor shall remove and dispose of the underground storage tanks as detailed on the enclosed drawing. These are old heating oil tanks and shall be removed and disposed of in their entirety. Owner will remove any remaining fluid prior to Contractor's work.

3. General

A. Contractor shall ensure that a 40-hour asbestos-trained project supervisor is in attendance during all phases of the work.

B. The most stringent regulations in effect for the work site shall apply. Contractor shall determine the extent of city, county, state, federal and all other applicable regulations and perform the work in compliance with these regulations.

C. Contractor shall provide an English-speaking interpreter on-site any time Contractor personnel are non-English-speaking.

D. Damaged or “disturbed” block filler material shall be contained and removed to the disposal site as soon as practicable. Contractor shall exercise due care and caution to make the site secure from unauthorized entry. All asbestos-containing waste shall be transported in leak-tight containers.

E. All dimensions, quantities and areas provided in this scope of work are approximations to assist Contractor in determining the amount of ACM designated for removal. Contractor is entirely responsible for accurately determining the amount of ACM included in the scope of work.

END OF SECTION

SECTION 024119 - SITE DEMOLITION

PART 1 - GENERAL

0.1 SUMMARY:

A. Section includes requirement for demolition work.
   1. Verify existing utilities to be removed as well as site features to be demolished with owner and engineer.

B. Demolition includes, but is not limited to, the removal of the following items within the demolition limit lines:
   1. Sidewalks
   2. Curbwalls
   3. Curb and Gutter
   4. Paving
   5. Concrete Slabs
   6. Water Lines and Meters
   7. Gas Lines
   8. Fencing
   9. Building Structures (below and above grade)
   10. Unmarked Trees and all their Roots, as noted
   11. Tree Stumps and all their Roots
   12. Sod, Lawn and all irrigated wet soils
   133. Shrubs and all their Roots
   14. Underground Structures including Septic Tanks, vaults, Basements
   15. Paint Obliteration

C. Related Sections
   1. Refer to Division 32 Section for earthwork requirements.

D. Drawings and general provisions of contract, including general and supplementary Conditions and site clearing specifications apply to work in this section.

0.2 SUBMITTALS:

A. Schedule: Submit proposed methods and operations of demolition to review prior to start of work. Include in schedule coordination for shut-off, capping, and continuation of utility services as required.

B. Explosives: The use of explosives is not permitted.

C. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
   1. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulation.

D. Protections: Ensure safe passage of persons around area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.
   1. Erect temporary covered passageways as required by authorities having jurisdiction.

2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

E. Damage: Promptly repair damage caused to adjacent facilities by demolition operations.
1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

F. Hazardous Materials Removal:
1. When hazardous materials are encountered, notify the Owner immediately.

PART 1 - PRODUCTS

Not used.

PART 2 - EXECUTION

A. Demolition:
1. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.
a. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
b. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations, as directed by Architect or governing authorities. Return adjacent areas to condition existing prior to start of work.

B. Cutting Asphalt, Concrete and Concrete Block: Saw cut asphalt paving, concrete slabs and concrete block walls with approved saws at lines and levels indicated on drawings. Saw cut concrete walks and curbs only if they cannot be removed to an existing control joint.

C. Capping and Abandonment: Cap all abandoned lines and conduits and drains in accordance with requirements of Utility Companies having jurisdiction. Remove abandoned lines, unless otherwise noted.

D. Permits: Contractor is required to obtain a Demolition Permit and Utility Disconnection Permits from the City and utility companies.
1. Record on Record Document location and extent of all capped and abandoned lines below grade.

E. Relocation: Relocate utilities as indicated. Work performed for relocation of utilities to conform to new utility line construction.

2.1 DISPOSAL OF DEMOLISHED MATERIALS:

A. General: remove from site debris, rubbish, and other materials resulting from demolition operations and dispose in a legal manner.

2.2 BACKFILL

A. Excavated areas associated with the removal of all substructures should be backfilled with a well-graded granular material having a maximum size of 2 inches and not more than 15 percent passing a #200 sieve. All earth materials placed in excavated areas should be placed in maximum eight inch loose lifts and densified to an in-place unit weight equal to 95% of the Maximum Laboratory Density as determined by ASTM D 1557-78.
   1. Refer to section 02300 for placement and compaction requirements.

END OF SECTION 024119

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.
4. Suspended slabs.

B. Cast in place surfaces shall be placed to provide an architectural quality as-cast finish, free of bug-holes, pillowing , surface irregularities, fins, or other imperfections that are unsightly in the finished work.

C. Related Sections include the following:
1. Division 01 Section “Sustainable Design Requirements” for LEED MR Credit MR 4 and 5
2. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
3. Division 32 Section "Concrete Paving" for concrete pavement and walks.
4. Division 32 Section "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

2. Product Data for Credit MR 5: Indicate manufacture and extraction or harvested or recovered distances from the site

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

F. Welding certificates.

G. Qualification Data: For testing agency.

H. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates.

I. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

J. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

K. Field quality-control test and inspection reports.

L. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

D. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

   1. ACI 301, "Specification for Structural Concrete."
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Mockups: Cast concrete **formed-surface** panels to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.

   1. Build panel approximately **100 sq. ft. (9.3 sq. m)** **for formed surface** in the location indicated or, if not indicated, as directed by Architect.
   2. Approved panels may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.

   2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, shoring and reshoring procedures, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
   a. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1-1/2 inches to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1-1/2 inches in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Deformed-Steel Wire: ASTM A 496.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I or I/II. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C 330 3/4-inch nominal maximum aggregate size.

E. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

1. Available Products:

a. Boral Material Technologies, Inc.; Boral BCN.
b. Euclid Chemical Company (The); Eucon CIA.
c. Grace Construction Products, W. R. Grace & Co.; DCI.
d. Master Builders, Inc.; Rheocrete CNI.
e. Sika Corporation; Sika CNI.

D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Available Products:

a. Axim Concrete Technologies; Catexol 1000CI.
b. Boral Material Technologies, Inc.; Boral BCN2.
c. Cortec Corporation; MCI 2000
d. Grace Construction Products, W. R. Grace & Co.; DCI-S.
e. Master Builders, Inc.; Rheocrete 222+.
f. Sika Corporation; FerroGard-901.

2.7 FIBER REINFORCEMENT

A. Synthetic Fiber: non-fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1-1/2 inches long.

1. Available Products:

a. Monofilament Fibers:

1) Axim Concrete Technologies; Fibrasol IIP.
2) Euclid Chemical Company (The); Fiberstrand 100.
3) FORTA Corporation; Forta Mono.
4) Grace Construction Products, W. R. Grace & Co.; Grace MicroFiber.
5) Metalcrete Industries; Polystrand 1000.
6) SI Concrete Systems; Fibermix Stealth.

2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products:

a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edoco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambco Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, Div. of ChemRex; Confilm.
k. Meadows, W. R., Inc.; Sealtight Evapre.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
p. Unitex; Pro-Film.
q. US Mix Products Company; US Spec Monofilm ER.
r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. Burke by Edoco; Aqua Resin Cure.
c. ChemMasters; Safe-Cure Clear.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
f. Euclid Chemical Company (The); Kurez DR VOX.
g. Kaufman Products, Inc.; Thinfilm 420.
h. Lambert Corporation; Aqua Kure-Clear.
i. L&M Construction Chemicals, Inc.; L&M Cure R.
j. Meadows, W. R., Inc.; 1100 Clear.
k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
l. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
m. Tamms Industries, Inc.; Horncure WB 30.
n. Unitex; Hydro Cure 309.
o. US Mix Products Company; US Spec Maxcure Resin Clear.
p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating**, certified by curing compound manufacturer to not interfere with bonding of floor covering**.

Products:

a. Anti-Hydro International, Inc.; AH Clear Cure WB.
b. Burke by Edoco; Spartan Cote WB II.
c. ChemMasters; Safe-Cure & Seal 20.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Cure and Seal WB.
e. Dayton Superior Corporation; Safe Cure and Seal (J-18).
f. Euclid Chemical Company (The); Aqua Cure VOX.
g. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
h. Lambert Corporation; Glazecote Sealer-20.
i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
j. Meadows, W. R., Inc.; Vocomp-20.
k. Metalcrete Industries; Metcure.
l. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 150E.
m. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
n. Tamms Industries, Inc.; Clearseal WB 150.
o. Unitex; Hydro Seal.
p. US Mix Products Company; US Spec Hydrasheen 15 percent
q. Vexcon Chemicals, Inc.; Starseal 309.

2.9 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: **ASTM D 1751, asphalt-saturated cellulosic fiber**

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solidsper ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.0217-inch thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.10 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials:

1. Combined Fly Ash or Pozzolan: portland cement with fly ash or pozzolan not exceeding 15 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: Per the structural drawings.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 4 inches

B. Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: Per the structural drawings.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 4 inches.

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: Per the structural drawings.
2. Maximum Water-Cementitious Materials Ratio: 0.50-interior slabs, 0.45-exterior slabs.
3. Slump Limit: 4 inches plus or minus 1 inch.
4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent. Do not air-entrain interior slabs.
5. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: Per the structural drawings.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd.
3. Slump Limit: 4 inches plus or minus 1 inch.
4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
5. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Exposed vertical work shall exceed the requirements of ACI 117 and not allow bow or offset to exceed ¼ inch in any 100 sq foot area. Relationship to building lines shall not exceed ¼ inch in any 100 sq foot area. Offsets at form lines shall be class A and not exceed 1/8 inch offset

D. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

E. Construct forms tight enough to prevent loss of concrete mortar.

F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

I. **Chamfer** exterior corners and edges of permanently exposed concrete unless otherwise shown

J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
4. Space vertical joints in walls as indicated not to exceed 125 feet. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces **not exposed to public view**.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces **exposed to public view**.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

D. Light Sandblast Finish: For seat walls and other surfaces noted, provide smooth formed finish that will receive light sand blast finish to exposed fine aggregate in the finished surface.

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in 1 direction.

1. Apply scratch finish to surfaces **to receive mortar setting beds for bonded cementitious floor finishes**

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces **exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system**.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
   a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
   b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- (3.05-m-) long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed **1/8 inch (3.2 mm)**

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces **where ceramic tile is to be installed by either thickset or thin-set method**. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer **unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project**.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
   3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

   1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
   2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections: As indicated in the construction documents.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate dos not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION 033000

SECTION 034500 - PLANT-PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Precast architectural concrete units at fire pit

B. Related Sections include the following:

1. Division 3 Sections for "Cast In Place concrete
2. Division 7 Section "Joint Sealants" for elastomeric joint sealants and sealant backings.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide precast architectural concrete units and connections capable of withstanding design loads within limits and under conditions indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixes: For each concrete mix.

C. Shop Drawings: Detail fabrication and installation of precast architectural concrete units. Indicate member locations, plans, elevations, dimensions, shapes, cross sections, limits of each finish, and types of reinforcement, including special reinforcement.

1. Indicate separate face and backup mix locations and thicknesses.
2. Indicate locations and extent and treatment of dry joints if two-stage casting is proposed.
3. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, inserts, connections, and joints, including accessories.
4. Indicate locations and details of anchorage devices to be embedded in other construction.
5. Indicate locations and details of thin brick units and joint treatment.
6. Indicate locations and details of stone facings, anchors, and treatment of joints.
7. Comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation.

D. Samples: For each type of finish indicated on exposed surfaces of precast architectural concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).

E. Welding Certificates: Copies of certificates for welding procedures and personnel.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

G. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Concrete materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Water-absorption test reports.
6. Thin brick units and accessories.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed precast architectural concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in manufacturing precast architectural concrete units similar to those indicated for this Project and with a record of successful in-service performance.

1. Assumes responsibility for engineering precast architectural concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
2. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of precast architectural concrete that are similar to those indicated for this Project in material, design, and extent.
3. Participates in PCI's Plant Certification program and is designated a PCI-certified plant for Group A, Category A1--Architectural Cladding and Load Bearing Units.
4. Has sufficient production capacity to produce required units without delaying the Work.

C. Testing Agency Qualifications: An independent testing agency**, acceptable to authorities having jurisdiction,** qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

D. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete."

E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

F. Product Options: Drawings indicate size, profiles, and dimensional requirements of precast concrete units and are based on the specific types of units indicated.

G. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.4, "Structural Welding Code--Reinforcing Steel."

H. Sample Panels: Before fabricating precast architectural concrete units, produce sample panels to establish the approved range of selections made under sample Submittals and to match existing to remain. Produce a minimum of 3 sets of full-scale sample panels, approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high, to demonstrate the expected range of finish, color, and texture variations.

1. Locate panels where indicated or, if not indicated, as directed by Architect.
2. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of surface blemishes to match adjacent undamaged surfaces.
3. Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
4. Demolish and remove sample panels when directed.

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver precast architectural concrete units to Project site in such quantities and at such times to ensure continuity of installation. Store units at Project site to prevent cracking, distorting, warping, staining, or other physical damage, and so markings are visible.

B. Lift and support units only at designated lifting and supporting points as shown on Shop Drawings.

1.7 SEQUENCING

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MOLD MATERIALS

A. Molds: Provide molds and, where required, form-facing materials of metal, plastic, wood, or another material that is nonreactive with concrete and dimensionally stable to produce continuous and true precast concrete surfaces within fabrication tolerances and suitable for required finishes

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Plain-Steel Wire: ASTM A 82, as drawn.

D. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

E. Supports: Manufacturer's bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to CRSI's "Manual of Standard Practice," PCI MNL 117, and as follows:

1. For uncoated reinforcement, use all-plastic bar supports.

2.3 PRESTRESSING TENDONS

A. Prestressing Strand: ASTM A 416/A 416M, Grade 250 or 270 (Grade 1725 or 1860), uncoated, 7-wire, low-relaxation strand.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III, **white**, of same type, brand, and source.

1. Standard gray portland cement may be used for nonexposed backup concrete.

B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S.

1. Face-Mix Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining.

a. Gradation: **Uniformly graded.**

2. Face-Mix Fine Aggregates: Selected, natural or manufactured sand of the same material as coarse aggregate, unless otherwise approved by Architect.

C. Lightweight Aggregates: Except as modified by PCI MNL 117, ASTM C 330, with absorption less than 11 percent.

D. Coloring Admixture: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures, temperature stable, nonfading, and alkali resistant.

E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

G. Water-Reducing Admixture: ASTM C 494, Type A.

H. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

I. Plasticizing Admixture: ASTM C 1017.

2.5 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

B. Carbon-Steel Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished; AWS D1.1, Type A or B, with arc shields.

C. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30 (Grade 415-205).

D. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.

E. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.

F. Anchor Bolts: ASTM F 1554 GR 55 headed or ASTM F1554 GR 105 headed bolts All anchor bolts use ASTM A563 heavy hex nuts and hardened washers, grade A, unless otherwise indicated.

G. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply **lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in FS TT-P-664**

H. Welding Electrodes: Comply with AWS standards.

I. Accessories: Provide clips, hangers, plastic shims, and other accessories required to install precast architectural concrete units.

2.6 BEARING PADS

A. Provide bearing pads for precast architectural concrete units as follows:

1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A durometer, minimum tensile strength 2250 psi (15.5 MPa) per ASTM D 412.
2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer.
3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A durometer.
4. Frictionless Pads: Tetrafluoroethylene, glass-fiber reinforced, bonded to mild-steel plate, of type required for in-service stress.
5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.7 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application.

2.8 CONCRETE MIXES

A. Prepare design mixes for each type of concrete required.

1. Limit use of fly ash to not exceed, in aggregate, 25 percent of portland cement by weight.

B. Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast architectural concrete fabricator's option.

C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318 (ACI 318M).

D. Normal-Weight Concrete Face and Backup Mixes: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa).
2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: 12 to 14 percent by volume, tested according to PCI MNL 117.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

G. When included in design mixes, add other admixtures to concrete mixes according to manufacturer's written instructions.

2.9 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

B. Furnish loose steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast architectural concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in precast architectural concrete units to receive windows, cramps, dowels, reglets, waterstops, flashings, and other similar work as indicated.

D. Cast-in openings larger than 10 inches (250 mm) in any dimension.

E. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" and PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcement to maintain at least 3/4-inch (19-mm) minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce precast architectural concrete units to resist handling, transportation, and erection stresses.

G. Prestress tendons for precast architectural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.

1. Delay detensioning or posttensioning of precast, prestressed architectural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under the same conditions as concrete.

H. Mix concrete according to PCI MNL 117 and requirements in this Section. After concrete batching, no additional water may be added.

I. Place face mix to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover.

J. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 117 for measuring, mixing, transporting, and placing concrete.

1. Place backup concrete to ensure bond with face mix concrete.

K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL 117.

L. Comply with ACI 306.1 procedures for cold-weather concrete placement.

M. Comply with ACI 305R recommendations for hot-weather concrete placement.

N. Identify pickup points of precast architectural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast architectural concrete unit on a surface that will not show in finished structure.

O. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.

P. Discard precast architectural concrete units that are warped, cracked, broken, spalled, stained, or otherwise defective unless repairs are approved by Architect.

2.10 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing operations.

B. Maintain molds to provide completed precast architectural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Edge and Corner Treatment: Uniformly **chamfered** unless otherwise shown.

2.11 FABRICATION TOLERANCES

A. Fabricate precast architectural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

B. Fabricate precast architectural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with the following product tolerances:

1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:

   a. 3 to 20 feet or under, plus or minus 1/8 inch (3 mm).

2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:

   a. 10 feet (3 m) or under, plus or minus 1/4 inch (6 mm).

3. Total Thickness: Plus 1/4 inch (6 mm), minus 1/8 inch (3 mm).
4. Rib Thickness: Plus or minus 1/8 inch (3 mm).
5. Rib to Edge of Flange: Plus or minus 1/8 inch (3 mm).
6. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches (3 mm per 2 m) not greater tha 3/8 inch total
7. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/4 inch (6 mm).
8. Location and Dimension of Block-outs Hidden from View and Used for HVAC and Utility Penetrations: Plus or minus 3/4 inch (19 mm).
9. Bowing: Plus or minus L/360, maximum 3/4 inch .
10. Local Smoothness: 1/4 inch per 10 feet (6 mm per 3 m).
11. Warping: 1/16 inch per 12 inches (1.5 mm per 300 mm) of distance from the nearest adjacent corner.
12. Tipping and Flushness of Plates: Plus or minus 1/4 inch (6 mm).

13. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch (3 mm).

C. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.

1. Weld Plates: Plus or minus 1 inch (25 mm).
2. Inserts: Plus or minus 1/2 inch (13 mm).
3. Handling Devices: Plus or minus 3 inches (75 mm).
4. Reinforcing Steel and Welded Wire Fabric: Plus or minus 1/4 inch (6 mm) where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch (13 mm).
5. Tendons: Plus or minus 1/4 inch (6 mm), vertical; plus or minus 1 inch (25 mm), horizontal.
6. Location of Rustication Joints: Plus or minus 1/8 inch (3 mm).
7. Location of Opening within Panel: Plus or minus 1/4 inch (6 mm).
8. Flashing Reglets: Plus or minus 1/4 inch (6 mm).
9. Flashing Reglets at Edge of Panel: Plus or minus 1/8 inch (3 mm).
10. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch (13 mm).
11. Allowable Rotation of Plate, Channel Inserts, Electrical Boxes: 2-degree rotation or 1/4 inch (6 mm) maximum over the full dimension of the unit.

2.12 FINISHES

A. Finish exposed-face surfaces of precast architectural concrete units to match approved **design reference sample** as follows:
1. PCI and APA's "Architectural Precast Concrete--Color and Texture Selection Guide," of plate numbers indicated.
2. Smooth-Surface Finish: Provide surfaces free of pockets, sand streaks, and honeycombs, with uniform color and texture.

B. Finish exposed surfaces of precast architectural concrete units by smooth, steel-trowel finish with Light acid wash or abrasive brush blast to remove paste and dull surface finish of panels.

C. Finish unexposed surfaces of precast architectural concrete units by float finish.

2.13 SOURCE QUALITY CONTROL

A. Owner will employ an independent testing agency to evaluate precast architectural concrete fabricator's quality-control and testing methods.

1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.

B. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements.

C. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 (ACI 318M) requirements.

D. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mix that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

E. Defective Work: Precast architectural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and finishes, are unacceptable. Replace with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Do not install precast concrete units until supporting concrete has attained minimum design compressive strength.

3.2 INSTALLATION

A. Install clips, hangers, and other accessories required for connecting precast architectural concrete units to supporting members and backup materials.

B. Install precast architectural concrete. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

1. Install bearing pads as precast concrete units are being erected.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting hoisting devices and use sand-cement grout to fill voids within recessed hoisting devices flush with surface of concrete.

C. Anchor precast architectural concrete units in position by bolting, welding, grouting, or as otherwise indicated. Remove temporary shims, wedges, and spacers as soon as possible after anchoring and grouting are completed.

D. Welding: Perform welding in compliance with AWS D1.1 and AWS D1.4, with qualified welders.

1. Protect precast architectural concrete units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.
2. Repair damaged steel surfaces by cleaning and repriming damaged painted surfaces.

E. At bolted connections, use lock washers or other acceptable means to prevent loosening of nuts.

F. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

3.3 ERECTION TOLERANCES

A. Install precast architectural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

B. Install precast architectural concrete units level, plumb, square, and true, without exceeding the following noncumulative erection tolerances.

1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch (13 mm).
2. Plan Location from Centerline of Steel: Plus or minus 1/2 inch (13 mm).
3. Top Elevation from Nominal Top Elevation: As follows:

    a. Exposed Individual Panel: Plus or minus 1/4 inch (6 mm).
    b. Nonexposed Individual Panel: Plus or minus 1/2 inch (13 mm).
    c. Exposed Panel Relative to Adjacent Panel: 1/4 inch (6 mm).
    d. Nonexposed Panel Relative to Adjacent Panel: 1/2 inch (13 mm).

4. Support Elevation from Nominal Support Elevation: As follows:

    a. Maximum Low: 1/2 inch (13 mm).
    b. Maximum High: 1/4 inch (6 mm).

5. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet (30 m): 1 inch (25 mm).
6. Plumb in Any 10 Feet (3 m) of Element Height: 1/4 inch (6 mm).
7. Maximum Jog in Alignment of Matching Edges: 1/4 inch (6 mm).
8. Joint Width (Governs over Joint Taper): Plus or minus 1/4 inch (6 mm).
9. Maximum Joint Taper: 3/8 inch (10 mm).
10. Joint Taper in 10 Feet (3 m): 1/4 inch (6 mm).
11. Maximum Jog in Alignment of Matching Faces: 1/4 inch (6 mm).
12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch (6 mm).

3.4 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Field welds and connections using high-strength bolts will be subject to tests and inspections.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS

A. Repair exposed exterior surfaces of precast architectural concrete units to match color, texture, and uniformity of surrounding precast architectural concrete if permitted by Architect.

B. Remove and replace damaged precast architectural concrete units if repairs do not comply with requirements.

3.6 CLEANING

A. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains.

1. Wash and rinse according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes.

END OF SECTION 034500

SECTION 042000 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:

1. Brick Veneer
2. Concrete Masonry Units, Decorative and Standard
3. Mortar and grout.
4. Reinforcing steel.
5. Masonry joint reinforcement.
6. Cavity wall insulation installed with masonry work.
7. Ties and anchors.
8. Miscellaneous masonry accessories.
9. Through Wall Flashing

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.

2. Division 7 Section “Building Insulation” for Outboard insulation in other wall assemblies.

3. Division 7 Section “Joint Sealers” for joint sealers in control joints to match masonry unit colors or as scheduled.
4. Division 7 Section “Air Barriers” for product applied to sheathing prior to cavity insulation.
5. Division 7 Section “Sheet Metal Flashing and Trim” for sheet metal flashing installed in masonry joints.
6. Division 6 “Panel Sheathing” for substrate behind brick veneer.

C. Products installed, but not furnished, under this Section include the following:

1. Steel lintels and relieving angles for unit masonry, furnished under Division 5 Section "Metal Fabrications."
2. Hollow-metal frames in unit masonry openings, furnished under Division 8 Section “Steel Doors and Frames.

1.3 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops the following net-area compressive strengths (f'm) at 28 days. Determine compressive strength of masonry from net-area compressive strengths of masonry units and mortar types according to Tables 2105.2.2.1.1 and 2105.2.2.1.2 in IBC 2009 or the prism test method section 2105.2.2.2 in IBC 2009.

1. For Brick Masonry: f'm = 2000 psi
2. For Concrete Unit Masonry: f'm = 1,500 psi unless otherwise noted on Structural Drawings.

1.4 SUBMITTALS

A. Product Data: For each different masonry unit, accessory, and other manufactured product specified.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
3. Precast and custom brick shape trim

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

D. Samples for Initial Selection: For the following:

1. Unit masonry Samples in small-scale form showing the full range of colors and textures available for each different exposed masonry unit required.
2. Mortar Samples showing the full range of natural colored mortar available.

E. Samples for Verification: For the following:

1. Full-size units for each different exposed masonry unit required, showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction.
2. Mortar Samples. Make samples using the same sand and mortar ingredients to be used on Project
3. Weep holes/vents in color to match mortar color.
4. Accessories embedded in the masonry.

F. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents, unless such deviations are specifically brought to the attention of the Architect and approved in writing.

B. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:

1. Each type of masonry unit required.

   a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.
   b. Include test results, measurements, and calculations establishing net-area compressive strength of masonry units.

2. Mortar complying with property requirements of ASTM C270.
3. Grout mixes complying with compressive strength requirements of ASTM C 476
4. Include description of type and proportions of grout ingredients.

D. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Each type of masonry unit required.

   a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.
   b. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.

2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
3. Each combination of masonry unit type and mortar type. Include statement of net-area compressive strength of masonry units, mortar type, and net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
4. Each material and grade indicated for reinforcing bars.
5. Each type and size of joint reinforcement.
6. Each type and size of anchor, tie, and metal accessory.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

E. Mockups: For fullscale mockup provide typical wall components to evaluate envelope, construction methods and conditions Large scale mock-up as required by other sections of these specifications.

F. Mockups: For demonstrating cleaning and setting methods of the masonry itself. Before installing unit masonry, build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Locate mockups in the locations indicated or, if not indicated, as directed by Architect.
2. Build mockup of typical wall areas for interior wainscot, exterior wall and all products as shown on Drawings.
3. Build mockups for the following types of masonry in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness, including face and backup wythes and accessories. Include a sealant-filled joint at least 16 inches (400 mm) long in each mockup.

   a. Typical exterior wall with corner of window opening framed with custom shapes Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
   b. Typical exterior wall with through-wall flashing installed for a 24-inch (600-mm) length in corner of mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing), complete with metal studs, sheathing, veneer ties, flashing, and weep holes and anti-graffiti coating/water repellant applied to surface of masonry.

4. Clean exposed faces of mockups with masonry cleaner as indicated.
5. Notify Architect seven days in advance of dates and times when mockups will be constructed.
6. Protect accepted mockups from the elements with weather-resistant membrane.
7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

   a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
   b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless such deviations are specifically approved by Architect in writing.

9. Demolish and remove mockups when directed.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

1. Protect Type I concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

A. Protection of Masonry: For walls exposed to elements, during construction and until masonry is protected by permanent construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

2. Failure to comply with these requirements may mean removal of unprotected, in-place work.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.

1. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

E. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602 and the Building Code.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

F. REQUIREMENTS FOR MASONRY CONSTRUCTION IN COLD WEATHER

Temperature (see note)	Construction Requirements	Protection Requirements
100 °F - 40 °F (38 °C - 4 °C)	Normal procedures.	Cover walls with plastic or canvas at end of work day to prevent water from entering masonry.
40 °F - 32 °F (4 °C - 0 °C)	Heat mixing water or sand to produce mortar between 40 °F - 120 °F (4 °C - 49 °C).	Completely cover newly constructed masonry with a weather resistant membrane for 48 hr after construction.
32 °F-25 °F (0 °C - –4 °C)	Heat mixing water and sand to produce mortar between 40 °F - 120 °F (4 °F - 49 °C). Heat grout materials so grout is placed at a temperature between 40 °F - 120 °F (4 °C - 49 °C) Maintain mortar and grout above freezing until used in masonry.	Completely cover newly constructed masonry with a weather resistant membrane for 48 hr after construction.
25 °F - 20 °F (–4 °C - –7 °C)	Heat mixing water and sand to produce mortar between 40 °F - 120 °F (4 °C - 49 °C). Heat grout materials so grout is placed between 40 °F - 120°F (4 °C - 49 °C). Maintain mortar and grout above freezing. Heat masonry units to 40 °F (4 °C) if grouting. Use heat sources on both sides of walls under construction.	Completely cover newly constructed masonry with insulating blankets or equal protection for 48 hr to prevent freezing. Install wind breaks when wind velocity exceeds 15 mph (6.7 m/s).
20 °F and Below (-7 °C and Below)	Heat mixing water and sand to produce mortar between 40 °F - 120 °F (4 °C - 49 °C). Heat grout materials so grout is placed between 40 °F - 120 °F (4 °C - 49 °C). Heat masonry units to 40 °F (4 °C). Use heat sources on both sides of walls under construction. Provide enclosure and heat to maintain temperatures above 32 °F (0 °C) within the enclosure.	Provide enclosure and heat to maintain temperatures above 32 °F (0 °C) within the enclosure for 48 hr after construction. Heat may be provided by electric heating blankets, infrared heat lamps or other approved methods.

PART 2 - PRODUCTS

2.1 BRICK

A. General: Provide shapes indicated and as follows for each form of brick required:

B. Face Brick: ASTM C 216 Grade SW, Type FBS, and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi (15.7 MPa).
2. Initial Rate of Absorption: Less than 20 g/30 sq. in. (20 g/194 sq. cm) per minute when tested per ASTM C 67.
3. Surface Coloring: Brick with surface coloring, other than flashed or sand-finished brick, shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m).
4. Size: Manufactured to the following actual dimensions:

   a. Modular Unit: 3-9/16 wide by 2-1/4 inches high by 7 5/8 nominal length.

5. Colors: Interstate Brick Golden Buff - campus standard field brick; an accent color brick to be selected. Both to match that in place on Building 1 on the Residential Life Campus

2.2 CONCRETE MASONRY UNITS

A. General: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.

2. All outside corners of exposed units to be factory fabricated bullnose configuration.

B. Concrete Masonry Units: ATM C 90 and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3750 psi.
2. Weight Classification: Light weight.
3. 1 hour rated where indicated
4. Size (Width): Manufactured to the following dimensions:

   a. 4 inches, 3 5/8 inches actual
   b. 6 inches, 5 5/8 inches actual
   c. 8 inches; 7-5/8 inches actual.
   d. 10 inches nominal; 9-5/8 inches actual.
   e. 12 inches nominal; 11-5/8 inches actual.

C. CMU Schedule

Design Standards establish a level of quality, color and finish for the work and are not to be construed as a limit of competition or a restraint of trade.
CMU Types:

No.	Style	Color		
1	Honed,	8”H x 16”W	Exposed to View	beige/gray range TBD
2	Standard-faced	8”H x 16”W	concealed from View	standard Color

3. Honed both faces beige/gray range TBD

Manufacturers must match the color, aggregate, appearance & texture of the selected types. Manufacturers that may be utilized in the Work include, but are not limited to, the following:

Amcor Masonry Products

Buehner Block

Lehi Block

Sunroc

2.3 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C 91.

1. Available Products:

a. Capital Materials Corporation; Flamingo Color Masonry Cement.
b. Essroc, Italcementi Group; Brixment.
c. Holcim (US) Inc.; Mortamix Masonry Cement
d. Lafarge North America Inc.;Lafarge Masonry Cement
e. Lehigh Cement Company; Lehigh Masonry Cement.
f. National Cement Company, Inc.; Coosa Masonry Cement.

B. Colored Cement Product: Packaged blend made from masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color as selected by Architect.
2. Pigments shall not exceed 5 percent of masonry cement by weight.
3. Available Products:

a. Colored Masonry Cement:

1) Capital Materials Corporation; Flamingo Color Masonry Cement.
2) Essroc, Italcementi Group; Brixment-in-Color.
3) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
4) Lafarge North America Inc.; Florida Custom Color Masonry or Magnolia Masonry Cement.
5) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
6) National Cement Company, Inc.; Coosa Masonry Cement.

C. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

D. Aggregate for Grout: ASTM C 404.

E. Water: Potable.

2.4 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and Division 07 Section "Sheet Metal Flashing and Trim" and as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.40 mm) thick.
2. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing drip edge out from wall, with outer edge bent down 30 degrees and hemmed.
4. Fabricate through-wall flashing with sealant stop where indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.

B. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counter-flashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is fully concealed, use metal flashing.

2.5 REINFORCING STEEL

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M; ASTM A 616/A 616M, including Supplement 1; or ASTM A 617/A 617M, Grade 60.

2.6 ADJUSTABLE MASONRY-VENEER ANCHORS

A. General: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

1. Structural Performance Characteristics: As indicated in the structural drawings.

B. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint, complying with the following requirements:

1. As indicated in the structural drawings but not less than 9 ga.

C. Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange by not less than 3 exposed threads, and with the following corrosion protective coating:

1. Organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.

2.7 MISCELLANEOUS ANCHORS

A. Post-installed Anchors: Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
2. For Post installed Anchors in Concrete: Capability to sustain, without failure, a load equal to four times the loads imposed.
3. For Post installed Anchors in Grouted Masonry Units: Capability to sustain, without failure, a load equal to six times the loads imposed.
4. Post installed anchors for structural applications shall be reviewed for use by the engineer of record.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips to be used in control joints, complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

C. Weep/Vent Products:
1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

D. Cavity Drainage Material: thickness to match cavity dimension, free-draining mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings.

1. Cavity Drainage Material:

a. Mortar Break; Advanced Building Products, Inc.
b. CavClear Masonry Mat; CavClear.
c. Mortar Net; Mortar Net USA, Ltd.
d. Mortar Stop; Polytite Manufacturing Corp.

2.9 CAVITY-WALL INSULATION

A. Exterior Insulation: Glass-fiber-reinforced enhanced polyisocyanurate foam core sheathing faced with embossed aluminum or glass facing on each face , complying with ASTM C1289 and meeting the following physical properties:
1. ASTM C1289 Type 1, Class 2
2. Compressive Strength (ASTM D1621): 20 psi, minimum.
3. Aged Thermal Resistance (ASTM C518, measured at Mean Temp of 75F): R-6.5 at 1 inch thickness
4. Flexural Strength (ASTM C203): Minimum 40 psi.
5. Water Absorption (ASTM C209): Maximum.1.0 percent by volume.
6. Water Vapor Permeance (ASTM E96): <1.0 perms.
7. Maximum Use Temperature: 250 degrees F.

B. Acceptable Products: include, but are not limited to, the following:

The Dow Chemical Company "THERMAX™ ci Exterior Insulation."
Hunter Panels Xci CG

1. Thickness and Stabilized R-Value: Nominal 0.625 inch thickness 2 inch thickness, R-12.0
2. Panel Sizes to fit between masonry ties.

C. Mechanical Fasteners: Type recommended by insulation board manufacturer for application indicated.

2.10 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.

B. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Available Products: Subject to compliance with requirements, products that may be used to clean unit masonry surfaces include, but are not limited to, the following:

a. Cleaners for Red and Light-Colored Brick Not Subject to Metallic Staining with Mortar Not Subject to Bleaching:

1) 202 New Masonry Detergent; Diedrich Technologies, Inc.
2) Sure Klean No. 600 Detergent; ProSoCo, Inc.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification.

1. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
2. Use Type S for reinforced masonry and interior non-load bearing partitions.

D. Grout for Unit Masonry: Comply with ASTM C 270.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
2. Verify that reinforcing dowels are properly placed.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown.

B. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.

3.3 CONSTRUCTION TOLERANCES

A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

B. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

C. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, nor 1/2 inch maximum.

D. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

E. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

F. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/16 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/16 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
   1. As indicated on Drawings.

C. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

F. Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.

G. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
   3. At fire-rated partitions, install firestopping in joint between top of partition and underside of structure above to comply with Division 7 Section "Firestopping."

3.5 CAVITY WALLS

A. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

B. Installing Cavity-Wall Insulation: Place small dabs of adhesive compatible with air barrier, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards,

or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.6 MORTAR BEDDING AND JOINTING

A. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.

B. Set trim units in full bed of mortar with vertical joints slushed full. Fill dowel, anchor, and similar holes solid. Wet stone-joint surface thoroughly before setting; for soiled surfaces, clean bedding and exposed surfaces with fiber brush and soap powder and rinse thoroughly with clear water.

3.7 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten each anchor section through sheathing to wall framing with two metal fasteners of type indicated. Provide additional strip of self adhering flashing compatible with air barrier where anchor contacts sheathing.

2. Set anchor in strip of self adhesive sheet flashing material compatible with air barrier system to provide air-tight performance with anchor in place/
3. Embed connector sections and continuous wire in masonry joints. Provide not less than the dimensioned air space as shown between back of masonry veneer and face of sheathing.
4. Locate anchor sections to allow maximum vertical differential movement of ties up and down. Connected directly into Metal stud flange.
5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally with not less than 1 anchor for each 2.0 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.

3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick made from clay or shale as follows:

1. Build in compressible joint fillers where indicated.
2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Division 7 Section "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants," but not less than 3/8 inch (10 mm).

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 LINTELS

A. Install steel lintels where indicated, welded to heavy gauge wall studs.

B. Provide lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units.

C. Provide minimum bearing of 6 inches at each jamb, unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

C. Install flashing as follows:

1. At masonry-veneer walls, extend flashing from exterior face of veneer, through veneer, up face of sheathing at least 8 inches (200 mm), and behind air-infiltration barrier. Set into butyl sealant as shown on details and flash into air barrier system with compatible transition strip approved by air barrier manufacturer.
2. At lintels and shelf angles, extend flashing a minimum of 4 inches (100 mm) into masonry at each end. At heads and sills, extend flashing 4 inches (100 mm) at ends and turn flashing up not less than 2 inches (50 mm) to form a pan. flash into air barrier system with compatible transition strip approved by air barrier manufacturer
3. Bed all flashings and transitions in mastic to prevent air infiltration.

D. Install weeps in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:

1. Use weep.

2. Space weep holes 16 inches (400 mm) o.c.
3. Place cavity drainage material immediately above flashing in cavities.

E. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
5. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.
6. Where amount of staining is severe, or detergent cleaning is ineffective, Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.12 MASONRY WASTE DISPOSAL

A. Recycling: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess, clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 044200 - DIMENSION STONE CLADDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

This Section includes the following types of dimension stone:

1. Panels mechanically anchored (field installed) on a metal-grid system.
2. Trim units, including copings, sills and jambs.
3. Stone caps for fire pit surround and walls set with individual anchors

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.
2. Division 5 Section "Cold-Formed Metal Framing" for steel studs supporting dimension stone cladding.
3. Division 7 Section “Water Repellants” for water repellant application to stone.
4. Division 7 Section “Fluid Applied Membrane Air Barrier” for coatings applied to substrate behind stonework.

1.3 DEFINITIONS

A. Definitions contained in ASTM C 119 apply to this Section.

B. Dimension Stone Cladding System: An exterior wall covering system consisting of dimension stone panels and trim together with anchors, backup structure, secondary weather barrier (sheathing), sheet air/vapor barrier, mortar, fasteners, and sealants used to secure the stone to building structure and to produce a weather-resistant covering.

1. Backup structure includes metal-grid system and miscellaneous steel framing required to secure stone to building structure.

1.4 PERFORMANCE REQUIREMENTS

A. General: Design stone anchors and anchoring systems according to ASTM C 1242.

B. Structural Performance: Provide dimension stone cladding system capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:

a. Uniform pressure of 30 lbf/sq. ft. (1436 Pa), acting inward or outward. See structural drawings.
b. Uniform pressure as indicated on structural drawings.

C. Seismic Performance: Provide dimension stone cladding system capable of withstanding the effects of earthquake motions determined according to ASCE 7.

1. Seismic Design Criteria: See structural drawings.

D. Thermal Movements: Provide dimension stone cladding system that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing displacement of stone, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Horizontal Building Movement (Interstory Drift): Allow for maximum horizontal building movement equal to quotient resulting from dividing floor-to-floor height at any floor by 400.

F. Shrinkage and Creep: Allow for progressive vertical shortening of building frame equal to 1/8 inch in 10 feet (3 mm in 3 m).

G. Safety Factors for Stone: Design dimension stone cladding system to withstand loads indicated without exceeding allowable working stress of stone determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:

1. Safety Factor for Quartz-Based sandstone: 6.

H. Design stone anchors and backup structure to withstand loads indicated without exceeding allowable working stresses established by the following:

1. For Structural Steel: AISC's "Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design."
2. For Cold-Formed Steel: AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

I. Limit deflection in each prefabricated assembly caused by indicated loads and thermal movements, acting singly or in combination with one another, to not more than 1/720 of assembly's clear span or the following, whichever is smaller:

1. 1/16 inch (1.5 mm), measured in plane of wall.
2. 1/4 inch (6 mm), measured perpendicular to wall.

J. Provisions for Fabrication and Erection Tolerances: Allow for fabrication and erection tolerances of building's structural system. Structural-steel fabrication and erection tolerances are specified in Division 5 Section "Structural Steel."

K. Provision for Deflection of Building Structure: Allow for the following:

1. Deflection due to Weight of Dimension Stone Cladding System: Allow for 1/4-inch (6-mm) vertical deflection in 20-foot (6-m) span of structural members supporting dimension stone cladding system.

2. Live Load Deflection: Allow for 1/4-inch (6-mm) vertical deflection, in 20-foot (6-m) span of structural members supporting dimension stone cladding system, due to live loads imposed on building's structural frame after stone installation.

L. Leakage Resistance, Water and Air: Provide dimension stone cladding system that complies with the following:

1. Air Infiltration: Not more than 0.004 cfm/sq. ft. (0.02 L/s per sq. m) of wall area, as measured by testing mockup per ASTM E 283 at a differential pressure of 1.57 lbf/sq. ft. (75 Pa).
2. Water Penetration: No uncontrolled water penetration beyond plane of back of dimension stone cladding system that is not contained or drained back to exterior, as measured by testing mockup per ASTM E 331 at a differential pressure of 20 percent of positive design wind load, but not less than 10 lbf/sq. ft. (479 Pa).

M. Control of Corrosion and Staining: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Use materials that do not stain exposed surfaces of stone and joint materials.

1.5 SUBMITTALS

A. Product Data: For variety of stone, stone accessory, and other manufactured products indicated.

B. Shop Drawings: Show fabrication and installation details for dimension stone cladding system, including dimensions and profiles of stone units.

1. Show locations and details of joints both within dimension stone cladding system and between dimension stone cladding system and other construction.
2. Include details of sealant joints.
3. Show locations and details of anchors and backup structure.
4. Include large-scale shaded elevations and details of decorative surfaces and inscriptions.
5. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

D. Samples for Initial Selection: For joint materials involving color selection.

E. Stone Samples for Verification: Sets for each color, grade, finish, and variety of stone required; not less than 12 inches (300 mm) square.

1. Sets shall consist of at least five Samples, exhibiting extremes of the full range of color and other visual characteristics expected and will establish the standard by which stone will be judged.

F. Sealant Samples for Verification: For each type and color of joint sealant required.

G. Welding certificates.

H. Qualification Data: For Installer, fabricator, professional engineer and testing agency.

I. Material Test Reports: From a qualified independent testing agency, as follows:

1. Stone Test Reports: For stone variety proposed for use on Project, provide test data indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous three years.
2. For metal components, indicate chemical and physical properties of metal.
3. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements in Division 7 Section "Joint Sealants" and indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.
4. Preconstruction Sealant Field Test Report: From Installer, complying with requirements in Division 7 Section "Joint Sealants."

J. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual experienced in installing dimension stone cladding systems similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.

B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate dimension stone cladding systems similar to that required for this Project and whose products have a record of successful in-service performance.

1. Fabricator's responsibilities include fabricating dimension stone cladding and providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Comprehensive engineering analysis by a qualified professional engineer.

C. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

D. Source Limitations for Stone: Obtain stone, regardless of finish, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.

1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
2. Make quarried blocks available for examination by Architect for appearance characteristics.

E. Source Limitations for Other Materials: Obtain each type of stone accessory, sealant, and other material from a single manufacturer for each product.

F. Preconstruction Stone Testing: Engage a qualified independent testing agency to perform preconstruction testing indicated below.

1. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
2. Furnish test specimens that are representative of materials proposed for incorporation into the Work.
3. Physical Property Tests: For stone variety proposed for use on Project, tested for compliance with physical property requirements, other than abrasion resistance, according to referenced ASTM standards.
4. Flexural Strength Tests: For stone variety, thickness, orientation of cut, and finish, proposed for use on Project, tested according to ASTM C 880, in both wet and dry conditions.
5. Anchorage Tests: For stone variety, orientation of cut, finish, and anchor type proposed for use on Project, tested according to ASTM C 1354.
6. Anchoring System Mockup Tests: For performance of stone anchoring system, evaluated for compliance with requirements by mockup testing per ASTM C 1201, Procedure B, with a maximum test load equal to 3 times the design load.
7. Cladding System Mockup Tests: For performance of dimension stone cladding system, evaluated for compliance with requirements by mockup testing per ASTM E 72, with a maximum test load equal to 3 times the design load.
8. Contractor is required to build test mockups of representative portion of dimension stone cladding system corresponding to area indicated on Drawings. Build test mockups at testing agency's facilities from same materials proposed for Project, using installers who will perform same tasks for Project.
9. Testing agency will report test results in writing to Architect and Contractor.

G. Preconstruction Sealant Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Division 7 Section "Joint Sealants," samples of materials that will contact or affect joint sealants.

H. Preconstruction Field Testing of Sealants: Before installing joint sealants, field test their adhesion to joint substrates per requirements specified in Division 7 Section "Joint Sealants."

I. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel"; and AWS D1.3, "Structural Welding Code--Sheet Steel."

J. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups of typical exterior wall with dimension stone cladding, approximately 15 feet (4.5 m) long by 10 feet (3 m) high.

   a. Show typical components, attachments to building structure, and methods of installation.
   b. Include sealant-filled joint complying with requirements in Division 7 Section "Joint Sealants."

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.

1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.

C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

1.8 PROJECT CONDITIONS

A. Protect dimension stone cladding during erection as follows:

1. Cover tops of dimension stone cladding installation with nonstaining, waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24 inches (600 mm) down both sides and hold securely in place.
2. Protect base of walls from rain-splashed mud by coverings spread on ground and over wall surface.
3. Protect sills, ledges, and projections from sealant droppings.

B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace dimension stone cladding damaged by frost or freezing conditions.

1. Comply with cold-weather construction and protection requirements for masonry contained in ACI 530.1/ASCE 6/TMS 602.

2. Cold-Weather Protection: When mean daily temperature is within limits indicated, provide the following protection for 48 hours after construction:

a. 40 to 25 Deg F (Plus 5 to Minus 4 Deg C): Cover dimension stone cladding with a weather-resistant membrane.
b. 25 to 20 Deg F (Minus 4 to Minus 7 Deg C): Cover dimension stone cladding with weather-resistant, insulating blankets or provide enclosure and heat to maintain air temperature above 32 deg F (0 deg C) within enclosure. Use windbreaks or enclosures when wind velocity exceeds 15 mph (25 km/h).

c. 20 Deg F (Minus 7 Deg C) and below: Provide enclosure and heat to maintain air temperature above 32 deg F (0 deg C) within enclosure.

C. Hot-Weather Requirements: Comply with hot-weather construction and protection requirements for masonry contained in ACI 530.1/ASCE 6/TMS 602.

D. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F (5 deg C) or when joint substrates are wet.

1.9 COORDINATION

A. Coordinate installation of inserts that are to be embedded in concrete or masonry, flashing reglets, and similar items to be used by dimension stone cladding Installer for anchoring, supporting, and flashing of dimension stone cladding system. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.

B. Time delivery and installation of dimension stone cladding to avoid extended on-site storage and to coordinate with work adjacent to dimension stone cladding.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Dimension Stone Units: Furnish two finished stone panels for each size used for each finish and variety of stone specified.

PART 2 - PRODUCTS

2.1 QUARTZ-BASED STONE (SANDSTONE)

A. Quartz-Based Stone: Comply with ASTM C 616, Classification I Sandstone or II Quartzitic Sandstone.

B. Varieties and Sources: Subject to compliance with requirements, provide the following: Red India Sandstone; “Morning Glory” as supplied by Southland Stone USA, Inc.; “Terra Cotta” as supplied by Amsum & Ash, or approved equal.

C. Finish: Natural cleft for building panels

D. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

E. Thickness: For wall panels Not less than 5 cm (nominal 2”), unless otherwise indicated. Panel size to be 24” x 36” or as shown on drawings.

F. Sandstone caps: Not less than 3 inches. Panel lengths as shown for radius application.

2.2 ANCHORS AND FASTENERS

A. Fabricate anchors, including shelf angles, from stainless steel, ASTM A 666, Type 304, temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A 276, Type 304.

B. Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.

1. For stainless steel, use annealed stainless-steel bolts, nuts, and washers; ASTM F 593 (ASTM F 738M) for bolts; and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).
2. For backup structure, use carbon steel bolts, nuts, and washers; ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), for bolts; ASTM A 563 (ASTM A 563M), Grade A, for nuts; and ASTM F 436 (ASTM F 436M) for washers; all hot-dip or mechanically zinc coated.

2.3 FRAMING FOR BACKUP STRUCTURE

A. Metal-Grid Systems: Provide manufacturer's standard integrated system that combines metal struts, fittings, fasteners, and stone anchors and that is engineered expressly for mechanically installing dimension stone cladding and that complies with the following requirements:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Canaren Inc.; A-Metal System.
   b. Georgia Marble Company; Zibell Anchoring System.
   c. Hohmann & Barnard, Inc.; HB Stone Support System.
   d. Meadow Burke; Halfen Anchoring System.

2. Struts: Cold-formed metal channels with continuous slot complying with MFMA-3, of size and shape required for application indicated, made from [galvanized steel complying with ASTM A 653/A 653M, with G90 (Z275) coating, and not less than 0.108-inch (2.74-mm) nominal thickness.
3. Fittings and Fasteners: System manufacturer's standard components of design, size, and material required to securely attach struts to building structure, by method indicated or selected, and stone anchors to struts, as well as to prevent galvanic corrosion. Fabricate components in contact with stone from same material specified for anchors.
4. Stone Anchors: Shapes and sizes standard with system manufacturer, complying with "Anchors and Fasteners" Article.

2.4 STONE ACCESSORIES

A. Concealed Sheet Metal Flashing: Fabricate from stainless steel in thicknesses indicated, but not less than 0.0156 inch (0.4 mm) thick.

B. Plastic Weep Hole/Vents: One-piece, flexible extrusion manufactured from UV-resistant polypropylene copolymer, designed to weep moisture in masonry cavity to exterior, in color selected from manufacturer's standard.

C. Sealants for Joints in Dimension Stone Cladding: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Division 7 Section "Joint Sealants" and do not stain stone.

1. Single-component, nonsag, urethane sealant.
2. Colors: Provide colors of exposed sealants to comply with the following requirement:

   a. Provide color as selected by Architect from manufacturer's full range.

D. Sealant for Filling Kerfs: Same sealant used for joints in dimension stone.

1. Single-component, nonsag, urethane sealant; Class 25, Use T (traffic), and Use M (masonry).
2. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Sika Corporation, Inc.; Sikaflex - 1a.
   b. Sonneborn, Division of ChemRex; NP 1.
   c. Sonneborn, Division of ChemRex; Ultra.
   d. Tremco, Sealant/Waterproofing Division; Vulkem 116.

E. Setting Shims: Strips of **resilient plastic or vulcanized neoprene, Type A Shore durometer hardness of 50 to 70**, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.

2.5 STONE FABRICATION

A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.

B. Control depth of stone and back check to maintain minimum clearance of 1 inch (25 mm) between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.

C. Dress joints (bed and vertical) straight and at right angle to face, unless otherwise indicated. Shape beds to fit supports.

D. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place.

E. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples.

F. Quirk-miter corners, unless otherwise indicated; provide for cramp anchorage in top and bottom bed joints of corner pieces.

G. Cut stone to produce uniform joints 3/8 inch (10 mm) wide and in locations indicated.

H. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.

I. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

J. Clean backs of stone to remove rust stains, iron particles, and stone dust.

K. Inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

2.6 SOURCE QUALITY CONTROL

A. Source Quality-Control Testing Service: Owner will employ an independent testing agency to perform source quality-control testing indicated below. Payment for these services will be made by Owner.

B. Source Quality-Control Testing Service: Engage a qualified independent testing agency to perform source quality-control testing indicated below.

1. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
2. Furnish test specimens selected by testing agency from same blocks as actual materials proposed for incorporation into the Work.
3. Flexural Strength Tests: ASTM C 880, performed on specimens of same thickness, orientation of cut, and finish as installed stone. One set of test specimens is required to be tested for every 5000 sq. ft. (500 sq. m), but not fewer than 2 sets.

C. Testing agency will report test results in writing to Architect and Contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive dimension stone cladding and conditions under which dimension stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of dimension stone cladding.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLING BACKUP STRUCTURE

A. Installing Metal-Grid Systems: Comply with manufacturer's written instructions to provide integrated system that combines metal struts, fittings, fasteners, and stone anchors.

1. Fasten struts by bolting to steel angle clips bolted to steel framing.
2. Fasten stone supports and anchors by bolting to struts.
3. Shim and adjust struts and stone supports and anchors to provide grid that is level, plumb, and true to line with no variation in plane or alignment exceeding 1/16 inch (1.5 mm) and no variation in position exceeding 1/8 inch (3 mm).

3.3 SETTING DIMENSION STONE CLADDING, GENERAL

A. Before setting stone clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

B. Execute dimension stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set.

1. Use power saws with diamond blades to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.

C. Contiguous Work: Provide reveals, reglets, and openings as required to accommodate contiguous work.

D. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure dimension stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.

E. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.

1. Sealing expansion and other joints is specified in Division 7 Section "Joint Sealants."
2. Keep expansion joints free of mortar and other rigid materials.

F. Install concealed flashing at continuous shelf angles, lintels, ledges, base and similar obstructions to downward flow of water to divert water to building exterior.

G. Keep cavities open where unfilled space is indicated between back of stone units and backup wall; do not fill cavities.

1. Place weep holes in joints where moisture may accumulate, including base of cavity walls, above shelf angles, and flashing. Locate weep holes at intervals not exceeding 24 inches (600 mm). Use plastic weep hole/vents.
2. Place vents in cavity walls at tops of cavities, below shelf angles and flashing, and at intervals not exceeding 20 feet (6 m) vertically. Locate vents in joints at intervals not exceeding 60 inches (1500 mm) horizontally. Use plastic weep hole/vents.

3.4 SETTING MECHANICALLY ANCHORED DIMENSION STONE CLADDING

A. Attach anchors securely to stone and into metal stud surfaces supporting sheathing. Comply with recommendations in ASTM C 1242.

B. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant indicated for filling kerfs.

C. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.

3.5 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Division 7 Section "Joint Sealants."

3.6 INSTALLATION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, corners and jambs within 20 feet (6 m) of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch in 40 feet (10 mm in 12 m) or more.

B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (10 mm) maximum.

C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (12 mm in 12 m) or more.

D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch (6 mm).

E. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less. For joints within 60 inches (1500 mm) of each other, do not vary more than 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less from one to the other.

F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch (1.5-mm) difference between planes of adjacent units.

3.7 FIELD QUALITY CONTROL

A. Field Quality-Control Water Leakage Test: Test dimension stone cladding system according to AAMA 501.2.

1. Notify Architect seven days in advance of dates and times when testing will be done.
2. Perform test at three locations as directed by Architect.
3. Report test results in writing to Architect and Owner.

3.8 ADJUSTING AND CLEANING

A. Remove and replace broken, chipped, stained, or otherwise damaged stone, defective joints, and dimension stone cladding that does not match approved samples and mockups. Damaged stone may be repaired if Architect approves methods and results.

B. Replace in a manner that results in dimension stone cladding's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean dimension stone cladding as work progresses. Remove mortar fins and smears before tooling joints. Remove excess sealant and smears as sealant is installed.

D. Final Cleaning: Clean dimension stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION 044200

SECTION 051200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fabrication and erection of structural steel work as shown on drawings including schedules, notes, and details showing size and location of members, typical connections, and types of steel required.

1. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR CreditS 4 and 5.
2. Refer to Division 3 for anchor bolt installation in concrete,
3. Division 4 for anchor bolt installation in masonry.
4. Miscellaneous Metal Fabrications are specified elsewhere in Division 5.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop drawings including complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.

1. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.
2. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:
   1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges," excluding the following Sections: 1.5.1; 3.3 (first sentence); 4.2; 4.2.1; 4.2.2; 7.5.4; and 7.11.5.
   2. AISC "Specifications for Structural Steel Buildings," including "Commentary."
   3. "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Structural Connections.
   4. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel."
   5. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

B. Fabricator Qualifications: Fabricator shall be approved and registered to perform all work without special inspection. (AISC or other equivalent certification as deemed acceptable by Owner). Where fabricator does not meet this criteria, fabricator testing and inspection shall be Contractor’s responsibility.

C. Qualifications for Welding Work: Qualify welding procedures and welding operators in accordance with AWS "Qualification" requirements.

   1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within the previous 12 months.
   2. If recertification of welders is required, retesting will be Contractor's responsibility.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.

B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not delay work.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. If bolts and nuts become dry or rusty, clean and relubricate before use.

   1. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: For fabrication of work that will be exposed to view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes.

B. Structural Steel Shapes, Plates, and Bars: As indicated.

C. Wide Flange Beams and Purlins: ASTM A-992, as indicated.

D. Cold-Formed Steel Tubing: As indicated.

E. Deformed Bar Anchors: As indicated.

F. Headed Stud Anchors: As indicated.

G. Anchor Bolts: As indicated.

H. High-Strength Threaded Fasteners: As indicated.

I. Direct Tension Indicators: ASTM F 959, type as required.

1. Use at Contractor's option.

J. Electrodes for Welding: Comply with AWS Code and General Structural Notes on Drawings.

K. Structural Steel Primer Paint: Rust- inhibiting alkyd-based primer paint.

L. Non-metallic Shrinkage-Resistant Grout: Premixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with CE-CRD-C621.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Sure Grip Grout; Dayton Superior.
   b. Euco N.S.; Euclid Chemical Co.
   c. Masterflow 713; Master Builders.
   d. Sealtight 588 Grout; W. R. Meadows.

2.2 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.

1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.

2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Connections: Weld or bolt shop connections, as indicated.

C. Bolt field connections, except where welded connections or other connections are indicated.

1. Provide high-strength threaded fasteners for all steel-to-steel bolted connections.

D. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts."

E. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

F. Assemble and weld built-up sections by methods that will produce true alignment of axes without warp.

G. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings.

H. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.

I. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 SHOP PAINTING

A. General: Shop-paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.

1. Do not paint surfaces to be welded or high-strength bolted with friction-type connections.
2. Do not paint surfaces indicated to receive sprayed-on fireproofing.

B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:

1. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning." For steel that remains exposed and receives painted finish.

C. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 1.5 mils. Use painting methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.4 SOURCE QUALITY CONTROL

A. General: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

1. Promptly remove and replace materials or fabricated components that do not comply.

B. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.

1. Promptly notify Architect whenever design of members and connections for any portion of structure are not clearly indicated.

PART 3 - EXECUTION

3.1 ERECTION

A. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

B. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.

C. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
3. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
4. For proprietary grout materials, comply with manufacturer's instructions.

D. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

E. Level and plumb individual members of structure within specified AISC tolerances.

F. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

G. Splice members only where indicated and accepted on shop drawings.

H. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

I. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

J. Do not enlarge unfair holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

K. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to Architect. Finish gas-cut sections equal to a sheared appearance when permitted.

L. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

3.2 FIELD QUALITY CONTROL

A. The Owner shall engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing will be required, and paid by the contractor, on deficient work to determine compliance of corrected Work with specified requirements.

3.3 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. K-series steel joists.
2. Joist accessories.

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4.1/4.2 and 5.1/5.2.

2. Division 04 Section "Unit Masonry assemblies" for installing bearing plates

1.3 DEFINITIONS

A. SJI "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.

B. Design special joists to withstand design loads with live load deflections no greater than the following:
1. Roof Joists: Vertical deflection of 1/240 of the span for total loads and 1/360 of the span for live loads.

1.5 SUBMITTALS

A. Product Data: For each type of joist, accessory, and product indicated.

B. Shop Drawings: Show layout, designation, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, joist accessories; splice and connection locations and details; and attachments to other construction.

1. Indicate locations and details of bearing plates to be embedded in other construction.
2. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

C. LEED Submittal:

1. Product Data for Credit MR 4.1/4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5.1 and 5.2: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

D. Welding certificates.

E. Manufacturer Certificates: Signed by manufacturers certifying that joists comply with requirements.

F. Mill Certificates: Signed by bolt manufacturers certifying that bolts comply with requirements.

G. Qualification Data: For manufacturer.

H. Field quality-control test and inspection reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables of SJI "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. SJI Specifications: Comply with standard specifications in SJI's "Specifications" that are applicable to types of joists indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel: Comply with SJI's "Specifications" for web and steel-angle chord members.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

C. Welding Electrodes: Comply with AWS standards.

2.2 PRIMERS

A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

B. Primer: Provide shop primer that complies with Division 09 painting Sections.

2.3 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

E. Camber joists according to SJI's "Specifications."

F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

C. Bridging: Fabricate as indicated and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

D. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface, unless otherwise indicated.

E. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.5 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by power-tool cleaning, SSPC-SP 3.

B. Apply 1 coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.

C. Field weld joists to supporting steel framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Field welds will be visually inspected according to AWS D1.1/D1.1M.

C. Bolted connections will be visually inspected.

D. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

E. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

F. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Roof deck.
2. Composite floor deck.

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.

2. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
3. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
4. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
5. Division 09 painting Sections for repair painting of primed deck.
6. Division 26 Section "Underfloor Raceways for Electrical Systems" for preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts used with cellular floor-deck systems.

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

D. Product Certificates: For each type of steel deck, signed by product manufacturer.

E. Welding certificates.

F. Field quality-control test and inspection reports.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.
2. Acoustical roof deck.

H. Research/Evaluation Reports: For steel deck.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

B. Source Limitations for Electrified Cellular Floor Deck: Obtain cellular floor-deck units and compatible electrical components, such as preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts, from same manufacturer.

C. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

E. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

F. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.

G. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

H. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.6 COORDINATION

A. Coordinate layout and installation of trench headers, preset inserts, duct fittings, and other components specified in Division 26 Section "Underfloor Raceways for Electrical Systems" with installation of electrified cellular metal floor deck.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steel Deck:

a. ASC Profiles, Inc.
b. Canam Steel Corp.;The Canam Manac Group.
c. Consolidated Systems, Inc.
d. DACS, Inc.
e. D-Mac Industries Inc.
f. Epic Metals Corporation.
g. Marlyn Steel Decks, Inc.
h. New Millennium Building Systems, LLC.
i. Nucor Corp.; Vulcraft Division.
j. Roof Deck, Inc.
k. United Steel Deck, Inc.
l. Valley Joist; Division of EBSCO Industries, Inc.
m. Verco Manufacturing Co.
n. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, painted.
2. Deck Profile: As indicated
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: Triple span or more.
6. Side Laps As indicated.

2.3 COMPOSITE FLOOR DECK

A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
   1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, painted.
   2. Profile Depth: As indicated.
   3. Design Uncoated-Steel Thickness: As indicated.
   4. Span Condition: Triple span or more.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

H. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

I. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

J. Galvanizing Repair Paint: ASTM A 780.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated as follows:

1. Weld Diameter: As indicated
2. Weld Spacing: As indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals as indicated, and as follows.

1. Fasten as indicated in the structural drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: As indicated.
2. Weld Spacing: Space and locate welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated in the structural drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches with end joints as follows:

1. End Joints Butted.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

F. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides, unless otherwise indicated.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent deck, to bottom surfaces of deck exposed to view.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Exterior non-load-bearing wall framing.

B. Related Sections include the following:

   1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.

   2. Division 05 Section "Metal Fabrications" for masonry shelf angles and connections.
   3. Division 09 Section "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
   4. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. LEED Submittal:

   1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

      a. Include statement indicating costs for each product having recycled content.

   2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Welding certificates.

D. Qualification Data: For testing agency.

E. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

F. Research/Evaluation Reports: For cold-formed metal framing.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

D. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

E. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Studco.
2. AllSteel Products, Inc.
3. California Expanded Metal Products Company.
4. Clark Steel Framing.
5. Consolidated Fabricators Corp.; Building Products Division.
6. Craco Metals Manufacturing, LLC.
7. Custom Stud, Inc.
8. Dale/Incor.
9. Design Shapes in Steel.
10. Dietrich Metal Framing; a Worthington Industries Company.
11. Formetal Co. Inc. (The).
12. Innovative Steel Systems.
13. MarinoWare; a division of Ware Industries.
14. Quail Run Building Materials, Inc.
15. SCAFCO Corporation.
16. Southeastern Stud & Components, Inc.
17. Steel Construction Systems.
18. Steeler, Inc.
19. Super Stud Building Products, Inc.
20. United Metal Products, Inc.

2.2 MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Sheet: ASTM A1011/A1011M-04, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As indicated in the structural drawings.
2. Coating: Galvanized.

C. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50, Class 1 or 2.
2. Coating: G90.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 16 gauge unless otherwise indicated.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as indicated.

C. Vertical Deflection Clips: As indicated in the structural drawings.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dietrich Metal Framing; a Worthington Industries Company.
b. MarinoWare, a division of Ware Industries.
c. SCAFCO Corporation
d. The Steel Network, Inc.

D. Rigid Connection Clips: Manufacturer's standard bypass or head clips, capable of supporting wall stud to primary structure.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10

times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or ASTM A 780.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

   a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

    1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:

    1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

    1. Install single-leg deflection tracks and anchor to building structure.
    2. Install double deep-leg deflection tracks and anchor outer track to building structure.
    3. Connect vertical deflection clips to bypassing studs and anchor to building structure.

4. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated in structural drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Steel ladders - roof access elevator pit
2. Loose bearing and leveling plates.
3. Loose steel lintels.
4. Shelf angles.
5. Steel framing and supports for mechanical and electrical equipment.
6. Pipe bollards
7. Skate Board deterrents
8. Steel framing and supports for applications where framing and supports are not specified in other Sections.

B. Related Sections include the following:

1. Division 5 Section "Structural Steel" for structural-steel framing system components.
2. Division 5 Section "Metal Stairs" for metal-framed stairs with metal pan treads and related railings.
3. Division 5 Section “Railings” for exterior pipe and tube railings and interior ornamental metal railings.
4. Division 14 Sections for Elevators for pit ladders and subsill support angles.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Paint products.
3. Grout.

B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1. Provide templates for anchors and bolts specified for installation under other Sections.

C. LEED Submittals:

1. Product Data for Credit MR 4 Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.

D. Samples for Verification: For each type and finish of extruded nosing and tread.

E. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

F. Welding Certificates: Copies of certificates for welding procedures and personnel.

G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.6 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.

C. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

D. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-3.

1. Size of Channels: **1-5/8 by 1-5/8 inches (41 by 41 mm)** unless otherwise **indicated**.
2. Material: Galvanized steel complying with ASTM A 653/A 653M, **structural steel, Grade 33**, with G90 (Z275) coating; **0.079-inch (2-mm)** nominal thickness.

E. Gray-Iron Castings: ASTM A 48, Class 30 (ASTM A 48M, Class 200), unless another class is indicated or required by structural loads.

F. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

G. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 STAINLESS STEEL

A. Castings: ASTM A 743/A 743M, **Grade CF 8 or CF 20**.

B. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, **Type 304**.

2.4 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance

to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FASTENERS

A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36.

D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Wood Screws: Flat head, carbon steel, ASME B18.6.1.

G. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).

H. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).

I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

J. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.6 GROUT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling

limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Shear and punch metals cleanly and accurately. Remove burrs.

C. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Remove sharp or rough areas on exposed traffic surfaces.

K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.8 STEEL LADDERS

A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.

1. Comply with ANSI A14.3, unless otherwise indicated.

B. Siderails: Continuous, 1/2-by-2-1/2-inch (12-by-64-mm) steel flat bars, with eased edges, spaced 18 inches (457 mm) apart.

C. Bar Rungs: 3/4-inch- (19-mm-) diameter steel bars, spaced 12 inches (300 mm) o.c.

D. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.

E. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.

F. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

G. Galvanize ladders at exterior locations.

2.9 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates after fabrication.

2.10 PIPE BOLLARDS

A. Fabricate pipe bollards from Schedule 40 steel pipe, galvanized for exterior application.

2.11 LOOSE STEEL LINTELS & RELIEVING ANGLES

A. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 6 inches, unless otherwise indicated.

D. Galvanize loose steel lintels located in exterior walls.

2.12 STAINLESS STEEL SKATEBOARD DETERRENTS

A. Stainless steel plate in shapes as shown embedded in stone cap joints or cast in place concrete with embed anchors configured to anchor in place without damaging substrate.

B. Form plate to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

2.13 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
   1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
   2. Furnish inserts if units must be installed after concrete is placed.

2.14 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.15 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

   1. ASTM A 123, for galvanizing steel and iron products.
   2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:

   1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.16 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

   1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.2 SETTING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING SKATE BOARD DETERRENTS

A. Locate and place Metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages embedded in stone or cast into concrete .

3.4 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any

3.5 INSTALLING PIPE BOLLARDS

A. Anchor bollards in place with concrete footings. Depth of embedment must match height of exposed pipe above finished grade. Support and brace bollards in position in footing excavations until concrete has been placed and cured.

B. Fill bollards solidly with concrete, mounding top surface.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior Steel stairs with concrete-filled treads designed and engineered to comply with local codes. For vertical circulation
2. Stainless Steel handrails and railings attached to metal stairs.
3. Handrails attached to walls adjacent to metal stairs.

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4.1/4.2 and 5.1/5.2.

2. Division 3 Section "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.

3. Division 5 Section “Interior Railings” for ornamental railings adjacent to Stairs in limited locations.

4. Division 5 Section “Railings” for Exterior assemblies.

1.3 SUBMITTALS

A. Product Data: For metal stairs and the following:

1. Prefilled metal-pan stair treads.
2. Paint products.
3. Grout.

B. Shop Drawings: Show fabrication and installation details for metal stairs. Include plans, elevations, sections, and details of metal stairs and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.

C. LEED Submittals:

1. Product Data for Credit MR 4.1 and 4.2: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5.1 and 5.2: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Arrange for metal stairs specified in this Section to be fabricated and installed by the same firm.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal stairs (including handrails and railing systems) that are similar to those indicated for this Project in material, design, and extent.

C. Fabricator Qualifications: A firm experienced in producing metal stairs similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.5 COORDINATION

A. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Metal Surfaces, General: Provide metal free from pitting, seam marks, roller marks, and other imperfections where exposed to view on finished units. Do not use steel sheet with variations in flatness exceeding those permitted by referenced standards for stretcher-leveled sheet.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500 Gr B.

D. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated.

E. Uncoated, Cold-Rolled Steel Sheet: Commercial quality, complying with ASTM A 366/A 366M; or structural quality, complying with ASTM A 611, Grade A, unless another grade is required by design loads.

F. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

G. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.2 STAINLESS STEEL

A. Tubing: ASTM A 554, **Grade MT 304**.

B. Pipe: ASTM A 312/A 312M, **Grade TP 304**.

C. Castings: ASTM A 743/A 743M, **Grade CF 8 or CF 20**.

D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, **Type 304**.

E. Bars and Shapes: ASTM A 276, Type **304**.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

D. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

E. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).

F. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

2.4 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664, selected for good resistance to

normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

2.5 GROUT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 CONCRETE FILL AND REINFORCING MATERIALS

A. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 3000 psi, unless higher strengths are indicated.

2.7 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding, unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Commercial class, interior stairs, unless otherwise indicated.

C. Shop Assembly: Preassemble stairs in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

D. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Shear and punch metals cleanly and accurately. Remove sharp or rough areas on exposed surfaces.

E. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously, unless otherwise indicated.
5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.7 STEEL-FRAMED STAIRS

A. Stair Framing: Fabricate stringers of structural-steel channels, tubes, plates, or a combination of both, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural-steel channel or tube steel headers and miscellaneous framing members as indicated. Bolt or weld headers to stringers; bolt or weld framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.

1. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

B. Metal Risers, Subtread Pans, and Subplatforms: Form to configurations shown from steel sheet of thickness indicated, but not less than 0.0677 inch.

1. Steel Sheet: Uncoated cold-rolled steel sheet, unless otherwise indicated.
2. Directly weld metal pans to stringers; locate welds on side of subtreads to be concealed by concrete fill. Do not weld risers to stringers.
3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
4. Shape metal pans to include nosing integral with riser.
5. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.8 STAINLESS STEEL TUBE HANDRAILS AND RAILINGS

A. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage.

1. Configuration: 1-1/2-inch round top tube with intermediate rails and panel sizes as shown.

B. Interconnect members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.

1. At tee and cross intersections, cope ends of intersecting members to fit contour of tube to which end is joined, and weld all around.

C. Form changes in direction of handrails and rails as follows:

1. By bending. flush-radius bends or inserting prefabricated flush-elbow fittings as applicable to condition and manufacturer’s standards as approved by Architect.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of handrail and railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting railings and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

1. Connect railing posts to stair framing by direct welding, unless otherwise indicated.

H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

I. Provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

J. Egress Gates: Provide hinged gates with hardware as noted for access control at locations if indicated. Fully welded assembly matching rail configurations of stairs as noted.

2.9 FINISHES

A. Comply with NAAMM'S "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed products:
1. Interiors (SSPC Zone 1A): SSPC SP 3, "Power Tool Cleaning."

D. Apply shop primer to prepared surfaces of metal stair components, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

2. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.10 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonmetallic, nonshrink grout, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING STAINLESS STEEL TUBE RAILINGS AND HANDRAILS

A. Adjust handrails and railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
1. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
3. For hollow masonry anchorage, use toggle bolts.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

END OF SECTION 055100

SECTION 055210 – PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Stainless steel railings at building exterior.

B. Related Sections:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.

2. Division 5 Section “Ornamental Railings” for stainless steel handrails .

1.3 DEFINITIONS

A. Definitions in ASTM E 985 for railing-related terms apply to this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General: In engineering handrail and railing systems to withstand structural loads indicated, determine allowable design working stresses of materials based on the following:

1. Stainless Steel: ASCE 8, "Specification for the Design of Cold-Formed Stainless Steel Structural Members."

B. Structural Performance of Handrails and Railing Systems: Engineer, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.

1. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:

a. Concentrated load of 300 lbf (890 N) applied at any point and in any direction.
b. Uniform load of 50 lbf per linear foot (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf per linear foot (1460 N/m) applied vertically downward.
c. Concentrated and uniform loads above need not be assumed to act concurrently.

2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:

   a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
   b. Uniform load of 50 lbf per linear foot (730 N/m) applied in any direction.
   c. Concentrated and uniform loads above need not be assumed to act concurrently.

3. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in the system including panels, intermediate rails, balusters, or other elements composing the infill area.

   a. Above load need not be assumed to act concurrently with loads on top rails of railing systems in determining stress on guard.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for manufacturer's standard product components used in handrails and railings.

C. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

D. Shop drawings showing fabrication and installation of handrails and railing systems including plans, elevations, sections, details of components, and attachments to other units of Work.

1. For installed handrails and railing systems indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for their preparation.

E. Samples for verification of each type of exposed finish required, prepared on components indicated below of same thickness and metal indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. 6-inch- (150-mm-) long sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.

2. Fittings and brackets.
3. Welded connections.
4. Assembled sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Sample need not be full height.

F. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" article.

1.6 QUALITY ASSURANCE

A. Engineer Qualifications: Professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated.

B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within the previous 12 months.
2. If recertification of welders is required, retesting will be Contractor's responsibility.

1.7 STORAGE

A. Store handrails and railing systems inside a well-ventilated area, away from uncured concrete and masonry and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.8 PROJECT CONDITIONS

A. Field Measurements: Where handrails and railing systems are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating handrails and railing systems without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Stainless-Steel Pipe and Tube Railings:

a. Alumaguard.
b. Architectural Art Mfg., Inc.
c. Blum: Julius Blum & Co., Inc.
d. CraneVeyor Corp.
e. KDI Paragon, Inc.
f. Stainless Fabricators, Inc.
g. Wagner: R & B Wagner, Inc.

2.2 METALS

A. General: Provide metals free from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.

C. Stainless Steel: Grade or type designated below for each form required:

1. Tubing: ASTM A 554; Grade 316L (exterior railings).
2. Pipe: ASTM A 312/A 312M; Grade TP 316L (exterior railings).
3. Castings: ASTM A 743/A 743M; Grade CF8M or CF3M (exterior railings).
4. Plate: ASTM A 666; Grade MT 316L (exterior railings).

B. Brackets, Flanges, and Anchors: Cast or formed metal of the same material and finish as supported rails, unless otherwise indicated.

2.3 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring railings to other types of construction indicated and capable of withstanding design loadings.

1. For stainless-steel handrails and railings, use fasteners fabricated from Type 304 or Type 316 stainless steel.
2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

C. Cast-in-Place and Postinstalled Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials, capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified, independent testing agency.

1. Cast-in-place anchors.
2. Chemical anchors.

2.4 ANCHORING CEMENT

A. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without need for protection by a sealer or waterproof coating and is recommended for exterior use by manufacturer.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Erosion-Resistant Anchoring Cement:

a. Bonsal Anchor Cement; W.R. Bonsal Co.
b. Super Por-Rok; Minwax Construction Products Division.

2.5 FABRICATION

A. General: Fabricate handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of hollow members, post spacings, and anchorage, but not less than those required to support structural loads.

B. Assemble handrails and railing systems in the shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

C. Form changes in direction of members as follows:

1. By radius bends of radius indicated.

D. Form curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

E. Welded Connections: Fabricate handrails and railing systems for connection of members by welding. For connections made during fabrication, weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At tee and cross intersections, cope ends of intersecting members to fit contour of pipe or tube to which end is joined, and weld all around.
5. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

F. Fasteners for Interconnecting Handrail and Railing Components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for handrails and railings indicated.
2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

G. Brackets, Flanges, Fittings, and Anchors: Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing system members to other construction.

H. Provide inserts and other anchorage devices to connect handrails and railing systems to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railing systems. Coordinate anchorage devices with supporting structure.

I. For railing posts set in concrete, provide core drilled holes or preset sleeves of stainless steel, not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (12 mm) greater than outside dimensions of post, and steel plate forming bottom closure.

J. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

K. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing work.

L. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

M. Provide weepholes, or another means to evacuate entrapped water, in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources.

N. Fabricate joints that will be exposed to weather in a manner to exclude water.

O. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is 1/4 inch (6 mm) or less.

P. Fillers: Provide steel sheet or plate fillers, of thickness and size indicated or required to support structural loads of handrails, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses to produce adequate bearing to prevent bracket rotation and overstressing substrate.

2.6 FINISHES, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

2.7 STAINLESS-STEEL FINISHES

A. Remove or blend tool and die marks and stretch lines into finish.

B. Grind and polish surfaces to produce uniform, directionally textured polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

1. Directional Satin Finish: No. 4.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installing anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors, that are to be embedded in concrete as masonry construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections accurately together to form tight, hairline joints.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing handrails and railing systems. Set handrails and railing systems accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.

1. Do not weld, cut, or abrade surfaces of handrails and railing components that have been coated or finished after fabrication and are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/4 inch in 12 feet (2 mm in 1 m).
3. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (2 mm in 1 m).

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and welded surface matches contours of adjoining surfaces.

D. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loadings.

E. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing handrails and railing systems and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact, or use fittings designed for this purpose.

3.4 ANCHORING POSTS

A. Anchor posts in concrete with pipe sleeves preset and anchored into concrete or holes core-drilled into the slab. After posts have been inserted into sleeves, solidly fill annular space between post and sleeve with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.

1. Anchoring cement.

B. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8-inch (3-mm) buildup, sloped away from post.

3.5 ADJUSTING AND CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

3.6 PROTECTION

B. Protect finishes of handrails and railing systems from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

C. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055210

SECTION 055300 - GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Heavy-duty metal bar gratings for air intakes
2. Metal frames, lock-downs and supports for gratings.
3. Exit Hatch door built into gratings

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.

2. Division 5 Section "Structural Steel" for structural-steel framing system components.
3. Division 5 Section "Metal Fabriations" for vertical steel ladders

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide gratings capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections:

1. Floors: Capable of withstanding a uniform load of 125 lbf/sq. ft. (6.00 kN/sq. m) or a concentrated load of 2000 lbf (8.90 kN), whichever produces the greater stress.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Clips and anchorage devices for gratings.
2. Paint products.

B. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: Show fabrication and installation details for gratings. Include plans, elevations, sections, and details of connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of gratings that are similar to those indicated for this Project in material, design, and extent.

B. Fabricator Qualifications: A firm experienced in producing gratings similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Metal Bar Grating Standards: Comply with applicable requirements of the following:

1. Heavy-Duty Metal Bar Gratings: Comply with NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

D. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."
3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.6 PROJECT CONDITIONS

A. Field Measurements: Where gratings are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating gratings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.7 COORDINATION

A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Metal Bar Gratings:

   a. Alabama Metal Industries
   b. All American Grating, Inc.
   c. Barnett/Bates Corp.
   d. Harris Steel Ltd.; Fisher & Ludlow Div.
   e. IKG Borden.
   f. Klemp Corp.
   g. Ohio Gratings, Inc.
   h. Seidelhuber Metal Products, Inc.
   i. Tru Weld Grating

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).

C. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy to be welded.

2.3 PAINT

A. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.4 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).

D. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).

E. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

2.5 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated.

E. Fit exposed connections accurately together to form hairline joints.

F. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

2.6 METAL BAR GRATINGS

A. Fabricate welded, heavy-duty steel gratings as follows:

1. Grating : 2 1/4-by-3/16-inch bearing bars with 19/16-inch clear space between bearing bars, and cross bars at 4 inches o.c. .

B. Traffic Surface for Steel Bar Gratings: As follows:

1. Plain.

C. Steel Finish: As follows:

1. Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.

D. Fabricate removable grating sections with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide not less than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
2. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.

a. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Grate-Fast" by Struct-Fast Inc.

E. Do not notch bearing bars at supports to maintain elevation.

2.7 GRATING FRAMES AND SUPPORTS

A. Steel Frames and Supports: Fabricate from structural-steel shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

B. Equip units with integrally welded anchors for casting into concrete or building into masonry.

1. Unless otherwise indicated, space anchors 24 inches (600 mm) o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long.

2. Galvanize frames and supports

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish gratings, frames, and supports after assembly.

C. Galvanizing: For those items indicated for galvanizing, apply zinc coating by the hot-dip process complying with ASTM A 123.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

3.3 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055300

SECTION 057200 – ORNAMENTAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Scope Requirements and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes steel and iron ornamental railings with mesh infill and plate cap toprail

B. Related Sections include the following:
1. Division 5 Section "Pipe and Tube Railings" for railings fabricated from pipe and tube components.
2. Division 6 Section "Miscellaneous Carpentry" for wood blocking for anchoring railings.
3. Division 9 Section for field Painted finish.

1.3 DEFINITIONS

A. Definitions in ASTM E 985 for railing-related terms apply to this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General: In engineering handrail and railing systems to withstand structural loads indicated, determine allowable design working stresses of materials based on the following:

1. Cold-Formed Structural Steel: AISI "Specification for the Design of Cold-Formed Steel Structural Members."

B. Structural Performance of Handrails and Railing Systems: Engineer, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.

1. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:

a. Concentrated load of 300 lbf (890 N) applied at any point and in any direction.
b. Uniform load of 50 lbf per linear foot (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf per linear foot (1460 N/m) applied vertically downward.
c. Concentrated and uniform loads above need not be assumed to act concurrently.

2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
   a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
   b. Uniform load of 50 lbf per linear foot (730 N/m) applied in any direction.
   c. Concentrated and uniform loads above need not be assumed to act concurrently.

3. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in the system including panels, intermediate rails, balusters, or other elements composing the infill area.

   a. Above load need not be assumed to act concurrently with loads on top rails of railing systems in determining stress on guard.

1.5 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for manufacturer's standard product components used in handrails and railings.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

D. Shop drawings showing fabrication and installation of handrails and railing systems including plans, elevations, sections, details of components, and attachments to other units of Work.

1. For installed handrails and railing systems indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for their preparation.

E. Samples for verification of each type of exposed finish required, prepared on components indicated below of same thickness and metal indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. 6-inch- (150-mm-) long sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Woven wire panels.
3. Fittings and brackets.
4. Welded connections.
5. Assembled sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Sample need not be full height.

F. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" article.

1.6 QUALITY ASSURANCE

A. Engineer Qualifications: Professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated.

B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within the previous 12 months.
2. If recertification of welders is required, retesting will be Contractor's responsibility.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.
2. Approve mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.7 STORAGE

A. Store handrails and railing systems inside a well-ventilated area, away from uncured concrete and masonry and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.8 PROJECT CONDITIONS

A. Field Measurements: Where handrails and railing systems are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating handrails and railing systems without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

PART 2 - PRODUCTS

2.1 METALS

A. General: Provide metals free from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.

B. Steel and Iron: Provide steel and iron in the form indicated, complying with the following requirements:

1. Steel Plates, Shapes, and Bars: ASTM A 36.

2. Gray Iron Castings: ASTM A 48, Class 30.
3. Malleable Iron Castings: ASTM A 47, Grade 32510.
4. Woven-Wire Mesh: Intermediate-crimp, rectangular pattern, 2-inch wide x 1-inch high woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 510 (ASTM A 510M).

    1. Make wire mesh and frames from steel.
    2. Orient wire mesh with wires parallel to stair run unless otherwise shown.

C. Brackets, Flanges, and Anchors: Cast or formed metal of the same material and finish as supported rails, unless otherwise indicated.

2.2 STAINLESS STEEL

A. Tubing: ASTM A 554, **Grade MT 316**

B. Pipe: ASTM A 312/A 312M, **Grade TP 316**.

C. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, **Type 316**.

D. Bars and Shapes: ASTM A 276, **Type 316**

2.3 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.4 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring railings to other types of construction indicated and capable of withstanding design loadings.

1. For steel railings and fittings, use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

C. Cast-in-Place and Postinstalled Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials, capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified, independent testing agency.

1. Cast-in-place anchors.
2. Chemical anchors.

2.5 FABRICATION

A. General: Fabricate handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of hollow members, post spacings, and anchorage, but not less than those required to support structural loads.

B. Assemble handrails and railing systems in the shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

C. Form changes in direction of members as follows:

2. By radius bends of radius indicated.

D. Form curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

E. Welded Connections: Fabricate handrails and railing systems for connection of members by welding. For connections made during fabrication, weld corners and seams continuously to comply with the following:

2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
3. Obtain fusion without undercut or overlap.
4. Remove welding flux immediately.
5. At tee and cross intersections, cope ends of intersecting members to fit contour of pipe or tube to which end is joined, and weld all around.
6. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

F. Brackets, Flanges, Fittings, and Anchors: Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing system members to other construction.

G. Provide inserts and other anchorage devices to connect handrails and railing systems to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railing systems. Coordinate anchorage devices with supporting structure.

H. For railing posts set in concrete, provide preset sleeves of steel, not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (12 mm) greater than outside dimensions of post, and steel plate forming bottom closure.

I. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

J. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing work.

K. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

L. Provide weepholes, or another means to evacuate entrapped water, in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources.

M. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.

N. Close exposed ends of handrail and railing members with prefabricated end fittings.

O. Fillers: Provide steel sheet or plate fillers, of thickness and size indicated or required to support structural loads of handrails, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses to produce adequate bearing to prevent bracket rotation and overstressing substrate.

2.6 RAILING INSERT PANELS

A. Mesh: 0.1920 inch- diameter, welded and crimped stainless steel wire woven into rectangular pattern, 2 x 2 inch pattern Lockcrimp weave Type 316 stainless with 82% open area Equal to McNichols Techna 8160.

B. Frames: as noted for stainless steel channels, continuously welded, supported as shown.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 STEEL AND IRON FINISHES

A. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed railings:
   1. Exterior Railings (SSPC Zone 1A): SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
   2. Interiors (SSPC Zone 1A): SSPC-SP 10"Near White Blast Cleaning."

D. Apply shop primer to prepared surfaces of railings, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

   Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installing anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors, that are to be embedded in concrete as masonry construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections accurately together to form tight, hairline joints.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing handrails and railing systems. Set handrails and railing systems accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.

   1. Do not weld, cut, or abrade surfaces of handrails and railing components that have been coated or finished after fabrication and are intended for field connection by mechanical or other means without further cutting or fitting.
   2. Set posts plumb within a tolerance of 1/4 inch in 12 feet (2 mm in 1 m).
   3. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (2 mm in 1 m).

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and welded surface matches contours of adjoining surfaces.

D. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loadings.

E. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing handrails and railing systems and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact, or use fittings designed for this purpose.

1. Grind welds smooth prior to finishing

3.4 ANCHORING POSTS

A. Bolt posts to structure shown

3.5 ADJUSTING AND CLEANING

A. Clean rails by wiping with a damp cloth and then wiping dry.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.6 PROTECTION

A. Protect finishes of handrails and railing systems from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057200

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Wood nailers, and blocking, pressure treated where in contact with masonry, roofing and concrete.
2. Wood blocking at all walls of suite toilet rooms for future ADA modifications (mounting grab bars and fixtures)
3. Wood blocking used at all wall mounted equipment, accessories, hardware and millwork
4. All interior blocking is fire treated.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section “Sustainable Design Requirements”
2. Division 7 Section for roofing.

1.3 DEFINITIONS

A. Miscellaneous Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:

1. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives, including printed statement of VOC content.
2. Product Data for Credit IEQ 4.4: For composite-wood products, documentation indicating that product contains no urea formaldehyde.

3. Certificates for Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.

   a. Include statement indicating costs for each certified wood product.

4. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.

D. Warranty of chemical treatment manufacturer for each type of treatment.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: To qualify for approval, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

B. Single-Source Responsibility for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product from one source and by a single producer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Fire-Retardant-Treated Materials, Interior Type A:

   a. Baxter: J. H. Baxter Co.
   b. Chemical Specialties, Inc.
   c. Continental Wood Preservers, Inc.
   d. Hickson Corp.
   e. Hoover Treated Wood Products, Inc.

2. Wood-Preservative-Treated Materials:

   a. Baxter: J. H. Baxter Co.
   b. Chemical Specialties, Inc.
   c. Continental Wood Preservers, Inc.
   d. Hickson Corp.
   e. Hoover Treated Wood Products, Inc.
   f. Osmose Wood Preserving, Inc.

2.2 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
   1. WCLIB - West Coast Lumber Inspection Bureau.
   1. WWPA - Western Wood Products Association.

C. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

   1. Provide dressed lumber, S4S, unless otherwise indicated.
   2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Comply with applicable requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL; U.S. Testing; Timber Products Inspection, Inc.; or another testing and inspecting agency acceptable to authorities having jurisdiction.

   1. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction and for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.

B. Interior Type A: For interior locations, use chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:

   1. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.
   2. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.
   3. Contact with treated wood does not promote corrosion of metal fasteners.

2.4 WOOD-PRESERVATIVE-TREATED MATERIALS

A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.

   1. Do not use chemicals containing chromium or arsenic.

B. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. (4.0 kg/cu. m). After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with concrete.

C. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft. (6.4 kg/cu. m).

D. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.5 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No.2 grade per SPIB;

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

B. Nails, Wire, Brads, and Staples: FS FF-N-105.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M)

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.

C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. CABO NER-272 for power-driven staples, P-nails, and allied fasteners.
2. Published requirements of metal framing anchor manufacturer.

E. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

3.2 WOOD NAILERS AND BLOCKING

A. Install wood nailers, blocking, and sleepers where shown and where required for attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

END OF SECTION 061053

SECTION 061600 – PANEL SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Scope Requirements and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Glass-mat gypsum sheathing board for wall applications with fully sealed joints

2. Cement based backer board for parapet applications where roof membranes and flashings may be adhesively applied.

B. Related Sections include the following:

1. Division 6 Section “Miscellaneous Carpentry” for blocking.
2. Division 7 Section for Air Barrier applied to face of sheathing.
3. Division 7 Section "**Sheet Metal Flashing and Trim** for flashing installed with gypsum sheathing.
4. Division 7 Section "**Joint Sealants** for sealants applied with gypsum sheathing.
5. Division 9 Section "**Gypsum Board Assemblies**" for steel framing, interior gypsum, exterior soffits and panels incorporated into assemblies with gypsum sheathing on the exterior.

1.3 DEFINITIONS

A. Gypsum Board Construction Terminology Standard: Refer to ASTM C 11 for definitions of terms for gypsum sheathing board construction not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittal:

1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For assembles with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from **UL's "Fire Resistance Directory."**

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, or other causes. Stack sheathing flat on leveled supports off the ground, under cover, and fully protected from weather.

1.7 COORDINATION

A. Glass-Mat Gypsum Sheathing Board:

1. Do not leave exposed to weather for more than 180 days.

PART 2 - PRODUCTS

2.1 GYPSUM SHEATHING

A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M.

1. Product: Subject to compliance with requirements, provide one of the following:

"Dens-Glass Gold" by G-P Gypsum Corporation.
“GlasRoc” Gypsum Sheathing by Certainteed
“Securock” by USG

2. Type and Thickness: **Type X, 5/8 inch (15.9 mm)** thick.
3. Size: **48 by 96 inches (1219 by 2438 mm)** for vertical installation.

2.2 CEMENT BACKER BOARD

A. Cementitious Backer Units: ANSI A118.9.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Custom Building Products; Wonderboard.
   b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
   c. United States Gypsum Co.; DUROCK Cement Board.

2.3 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant: Compatible with air barrier system installed over sheathing and compatible with sheathing tape and sheathing, recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Glass-Fiber Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

B. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, attach sheathing with drill screws complying with ASTM C 954.

PART 3 - EXECUTION

3.1 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and manufacturer's written instructions.

B. Cut boards at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

1. Install boards with a 3/8-inch (9-mm) setback where non-load-bearing construction abuts structural elements.
2. Install boards with a 1/4-inch (6.4-mm) setback where they abut masonry or similar materials that might retain moisture, to prevent wicking.
3. Install board to board with joints that do not exceed 1/8 inch in width.

C. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.

D. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.

E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.

F. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of stud flanges, and stagger end joints of adjacent boards not less than one stud spacing. Screw-attach boards at perimeter and within field of board to each steel stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9 mm) from edges and ends of boards.

3.2 SHEATHING JOINT-AND-PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written recommendations and as required for the air barrier system installer to provide a warranted installation.
   1. Apply sealant on joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
   2. for joints greater than 1/8 inch at structural and masonry conditions, fully seal joint and add joint tape fully bedded to create air-tight, watertight conditions.

3.3 CEMENT BASED PANELS

A. Backing Panel: Comply with manufacturer's written installation instructions and install **where indicated**. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
B. Seal all joints with sealant and joint tape to prevent water penetration.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior standing and running trim
2. Plastic-laminate cabinets.
3. Solid Surfacing countertops and windowsills

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.

2. Division 6 Section "Miscellaneous Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, including cabinet hardware and accessories, and finishing materials and processes.

B. Product Data: For hardboard, medium-density fiberboard, plywood, high-pressure decorative laminate, adhesive for bonding plastic laminate, thermoset decorative overlay, solid-surfacing material, metallic faced laminate, veneers, fire-retardant-treated materials, cabinet hardware and accessories, and finishing materials and processes.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.

2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for items installed in architectural woodwork.

D. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and glues used at Project site, including printed statement of VOC content.
2. Product Data for Credit IEQ 4.4: For composite-wood products, documentation indicating that product contains no urea formaldehyde.
3. Certificates for Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.

   a. Include statement indicating costs for each certified wood product.

E. Samples for Verification: For the following:
1. Plastic-laminate-clad panel products, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
2. Thermoset decorative-overlay surfaced panel products, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish.
3. Solid surfacing countertop and windowsill materials, 6 inches (150 mm) square.
4. Corner pieces as follows:

   a. Cabinet front frame joints between stiles and rail, as well as exposed end pieces, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.
   b. Miter joints for standing trim.

5. Exposed cabinet hardware and accessories, one unit for each type.

F. Product Certificates: Signed by manufacturers of woodwork certifying that products furnished comply with requirements.

1.5 QUALITY ASSURANCE

A. Forest Certification: Provide interior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production and installation of interior architectural woodwork

E. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.

1. Provide AWI Quality Certification Program certificate indicating that woodwork complies with requirements of grades specified.

F. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

G. Mockups: Before fabricating and installing interior architectural woodwork, build mockups for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be fabricated and installed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting interior architectural woodwork fabrication.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Mockup to be removed prior to time of Substantial Completion

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.

2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Division 8 Section "Door Hardware" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue.
3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
4. Softwood Plywood: DOC PS 1, Medium Density Overlay –

C. Thermoset Decorative Overlay: Particleboard complying with ANSI A208.1, Grade M-2, or medium-density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
a. Nevamar Company, LLC; Decorative Products Div.
b. Formica
c. Wilson Art

E. MDF: ANSI A208.2, Grade **130, made with binder containing no urea-formaldehyde resin**

F. Particleboard: ANSI A208.1, Grade **M-2 made with binder containing no urea-formaldehyde resin**.

G. Adhesive for Bonding Plastic Laminate: contact cement.

H. Steel and Iron: Provide steel and iron in form indicated to comply with the following requirements:

1. Tubing: Cold formed, ASTM A 500.
2. Steel Plate, Shapes, and Bars: ASTM A 36/A 36M.

I. Solid Surfacing:

1. Homogenous solid slabs of Quartz Surfacing equal to Caesarstone

2.Properties

Flexural Strength: 7,420 psi
Compressive Strength: ASTM C-170 – 10, 340 psi average
Izod impact strength Face X direction (ft/lb/inch-width) 0.361
Bond Strength : 205 psi
Modulus of rupture (flexibility)FaceX direction 2,110 psi
Mohs hardness 6.5 – 7.5 scratch test
Absorption 0.022% ASTM C97
Surface Burning Characteristics Flame Spread 1-0, smoke developed 195 ASTM E84
Wear Resistance: 36.12 gram average.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. Lumber: Comply with performance requirements in AWPA C20, I**nterior Type A**. Kiln dry after treatment to a maximum moisture content of 19 percent.

B. Plywood: Comply with performance requirements in AWPA C27, **Interior Type A**. Kiln dry after treatment to a maximum moisture content of 15 percent.

C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not contain colorants and provide materials that do not have marks from spacer sticks on the exposed face.

D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.

E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, **mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency**.
2. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

F. Application **All interior lumber and plywood**

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware."

B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.

C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening.

D. Wire Pulls: Back mounted, 4 inches (100 mm) long, 5/16 inches (8 mm) in diameter

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests,

F. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:

1. Box Drawer Slides: 100 lbf (440 N).
2. File Drawer Slides: 150 lbf (670 N).
3. Pencil Drawer Slides: 45 lbf (200 N).
4. Keyboard Slide: 75 lbf (330 N).

G. Door Locks: BHMA A156.11, E07121.

H. Drawer Locks: BHMA A156.11, E07041.

I. Grommets for Cable Passage through Countertops: 2-1/2, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Product: Subject to compliance with requirements, provide "OG series" by Doug Mockett and Co., Inc.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Stainless Steel: BHMA 630.

K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.5 FABRICATION, GENERAL

A. Interior Woodwork Grade: Provide Premium grade interior woodwork complying with the referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch (19 mm) Thick or Less: 1/16 inch (1.5 mm).
2. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).
3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

E. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

2.6 PLASTIC-LAMINATE CABINETS

A. Quality Standard: Comply with AWI Section 10 2009 STANDARDS requirements for laminate cabinets

B. AWI Type of Cabinet Construction: Flush overlay, unless otherwise shown.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: HGS.
2. Postformed Surfaces: HGP.
3. Vertical Surfaces: HGS.
4. Edges: 3 mm PVC

D. Materials for Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative overlay.
2. Drawer Sides and Backs: Thermoset decorative overlay.
3. Drawer Bottoms: Thermoset decorative overlay.

E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. Match Architect's sample.
2. Metal laminate base as shown on drawings.

F. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.7 SOLID SURFACING FABRICATION

A. General: Fabricate interior quartz or resin filled material solid surfacing in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings. Include windowsill profiles where shown. Comply with AWI Section 11 of 2009 STANDARDS

B. Cut and drill sinks and holes for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.

C. Cut product to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by stone source, for faces, edges, beds, and backs.

1. Thickness of solid surfacing Countertops and Windowsills: Provide thickness indicated, but not less than the following:
   a. Nominal Thickness: 3/4 inch.

2. Dress joints (bed and vertical) straight and at right angle to face, unless otherwise indicated.
3. Quirk-miter corners, unless otherwise indicated. Install anchorage in top and bottom bed joints of corner units.

4. Clean sawn backs of stones to remove rust stains and iron particles.

D. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

E. Finish exposed faces and edges of stone to comply with requirements indicated for finish under each type of stone required and to match approved samples and mockups.

F. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.
2. Fittings: Drill countertops in field for fittings, bracing, and similar items.

2.8 CLOSET AND UTILITY SHELVING

A. Grade: **Premium**

B. Shelf Material: 3/4-inch (19-mm) plywood with PVC edge trim finished in HPDL

C. Cleats: 3/4-inch (19-mm) **solid lumber**

D. Clothes Rods: 1-5/16-inch- (33-mm-) diameter, **aluminum tubes** or **chrome-plated steel tubes** .

1. Rod Flanges: **Aluminum or Stainless steel**.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Execution Standards of Sections referenced herein for the same grade specified in Part 2 of this Section for type of woodwork involved.

B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips

3.3 INSTALLING COUNTERTOPS AND WINDOWSILLS

A. Bond seams with seam adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to seams to prevent adhesive smears. Use clamps to ensure countertop units are properly aligned and seams are minimum width.

B. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts while cutting to prevent damage.

1. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

C. Align adjacent solid-surfacing-material pieces for countertops or sills and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

1. Install sills with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. Calk space between windowsill and wall or frame with sealant specified in Division 7 Section "Joint Sealants."

3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 066400 - FIBERGLASS REINFORCED PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fiberglass reinforced paneling (FRP) applied to wall surfaces in janitors closets and Food Service areas as scheduled.

B. Related Sections include the following:

1. Division 9 Section “Gypsum Drywall Assemblies” for substrate supporting paneling.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of product specified, including details of construction relative to materials, dimensions of individual components, profiles, and colors.

C. Samples for color selection purposes in form of manufacturer's sample finishes showing full range of colors available.

1.4 QUALITY ASSURANCE

A. Surface Burning Characteristics: Provide FRP panels identical to that tested for the following fire performance characteristics, per test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify FRP panels with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning; Test Method: ASTM E 84.
   a. Flame Spread: Class `A' flame spread of 0-25.
   b. Smoke Developed: 200 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's unopened bundles or containers with labels intact.

B. Handle and store materials at Project site to prevent water damage, staining, or other physical damage. Comply with manufacturer's recommendations for job site storage, handling and protection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide one of the following:

1. Fiberglass reinforced paneling:

   a. American Acrylic Corporation.
   b. Kemlite Co.
   c. Lasco Panel Products.
   d. Marlite.
   e. Nudo Products, Inc.

2.2 FIBERGLASS REINFORCED PANELING

A. Composition: Provide panels manufactured of modified resinous mixture reinforced with random chopped fiberglass roving.

1. Water absorption: .4 per ASTM D 570.
2. Thickness: 0.090 inch nominal.
3. Size: 4'-0" x 9'-0" sheets.
4. Finish: Manufacturer's standard USDA approved embossed textured pebbled finish.
5. Color: Provide selections made by Architect from manufacturer's full range of standard colors.

2.3 ACCESSORIES

A. Moldings: Manufacturer's standard extruded polyvinyl chloride moldings. Provide moldings such as division bars, inside and outside corners, and caps as appropriate to each kind of joint and edge condition and as appropriate for project for complete assembly.

B. Fasteners: Provide Manufacturers standard nylon drive rivets, color to match panel.

C. Panel Adhesive: Type recommended by panel manufacturer for substrate and conditions indicated.

D. Elastomeric Sealant: Mildew-resistant silicone sealant complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for substrates, installation tolerances, and other conditions affecting performance of paneling. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Coordinate installation with other adjoining construction to ensure proper sequencing.

3.3 INSTALLATION

A. Comply with paneling manufacturer's installation instructions and recommendations. Install panels using adhesive and mechanical fasteners. Install trim in accordance with manufacturer's recommendations to cover all panel edges and joints.

1. Allow for expansion at floors, ceiling, and between panels.
2. Oversize fastener holes and pre-drill to allow for expansion.
3. Space fasteners 8 inches apart around outside edges and 12 inches apart on intermediate 16 inch centers. Space exposed fasteners uniformly, plumb and level.
4. Use adhesive in conjunction with or substituting for mechanical fastening in accordance with manufacturer's recommendations where adhesive will anchor panels for conditions indicated.
5. Apply silicone sealant for a waterproof installation at all joints before or during installation of moldings.

3.4 CLEANING

A. Clean finished surfaces as recommended by manufacturer, and maintain in a clean condition during construction.

END OF SECTION 066400

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Scope Requirements and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Rubberized-asphalt sheet waterproofing at subgrade walls..

2. Drainage Panels

3. Protection Board

B. Related Sections include the following:

1. Division 33 Section “Subdrainage” for footing drainage system.

1.3 PERFORMANCE REQUIREMENTS

A. Provide waterproofing that prevents the passage of water.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who is **authorized, approved, or licensed by** waterproofing manufacturer to install manufacturer's products.

B. Source Limitations: Obtain waterproofing materials through one source from a single manufacturer.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

C. Samples: For the following products:

1. 12-by-12-inch (300-by-300-mm) square of waterproofing and flashing sheet.
2. 12-by-12-inch (300-by-300-mm) square of insulation.
3. 4-by-4-inch (100-by-100-mm) square of drainage panel.

D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for waterproofing.

G. Warranties: Special warranties specified in this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Store rolls according to manufacturer's written instructions.

E. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Written warranty, signed by waterproofing manufacturer agreeing to replace waterproofing material that does not comply with requirements or that does not remain watertight during specified warranty period.

1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch (1.6 mm) in width.
2. Warranty Period: **Five** years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work, include, but are not limited to, the following:

1. Rubberized-Asphalt Sheet Waterproofing:

a. American Hydrotech, Inc.; VM 75.
b. Carlisle Corporation, Carlisle Coatings & Waterproofing Div. Miradri 860/861
c. Polyguard 650, Polyguard Products Inc
d. W. R. Grace & Co.; Bituthene. 3000
e. W. R. Meadows, Inc.; Mel-Rol.

2.2 RUBBERIZED-ASPHALT SHEET WATERPROOFING

A. Rubberized-Asphalt Sheet: 60-mil- (1.5-mm-) thick, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated to a 4-mil- (0.10-mm-) thick, polyethylene film with release liner on adhesive side **and formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction**.

1. Physical Properties: As follows, measured per standard test methods referenced:

a. Tensile Strength: 325 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
c. Low-Temperature Flexibility: Pass at minus 25 deg F (minus 29 deg C); ASTM D 1970.
d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.
e. Puncture Resistance: 50 lbf (180 N) minimum; ASTM E 154.
f. Hydrostatic-Head Resistance: 200 feet (45 m) minimum; ASTM D 5385.
g. Water Absorption: 0.1 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
h. Vapor Permeance: 0.05 perms (2.9 ng/Pa x s x sq. m); ASTM E 96, Water Method.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid **waterborne** primer recommended for substrate by manufacturer of sheet waterproofing material.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.

D. Sheet Strips: Self-adhering, rubberized-asphalt composite sheet strips of same material and thickness as sheet waterproofing.

E. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.

F. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.

G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Manufacturers: Subject to compliance with requirements, products include the following:

1. American Wick Drain Corporation.
2. Grace, W. R. & Co.; Construction Products Div. Hydroduct 200
3. Carlisle, Miradri
4. Cosella Dorken

B. Description: Prefabricated, composite panels, 36 to 60 inches (915 to 1525 mm) wide, and manufactured with geotextile facing laminated to molded-plastic drainage core.

C. Drainage Core: Three-dimensional, nonbiodegradable, molded PP or PS.

1. Minimum Compressive Strength: **15,000 lbf/sq. ft. (479 kPa)** when tested according to ASTM D 1621.
2. Minimum Flow Rate: **16 gpm per foot (35 L/min. per m)** when tested according to ASTM D 4716.

D. Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with the following properties determined according to AASHTO M 288:

1. Survivability: Class **1**.
2. Apparent Opening Size: **No. 40 (0.43-mm)** sieve, maximum.
3. Permittivity: **0.5** per second, minimum.

E. Film Backing: Polymeric film bonded to drainage core surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids created by existing foundations to be waterproofed as recommended by the manufacturer.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install sheet strips and center over treated construction and contraction joints and cracks exceeding a width of **1/16 inch (1.6 mm)**.

F. Bridge and cover **isolation joints and** discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips.

1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane on horizontal inside corners and as follows:

a. At footing-to-wall intersections, extend liquid membrane each direction from corner or install membrane strip centered over corner.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 RUBBERIZED-ASPHALT SHEET APPLICATION

A. Install self-adhering sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, rubberized-asphalt sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).

D. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.

E. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic or sealant.

F. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheets extending 6 inches (150 mm) beyond repaired areas in all directions.

G. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements, repair substrates, reapply waterproofing, and repair sheet flashings.

3.4 PROTECTION COURSE INSTALLATION

A. Install vertical drainage panel as follows:

1. Coordinate placement with other drainage materials.
2. Coordinate with wrapping fabric to subdrainage pipe if provided in Division 2 Section.
3. Cut panel as necessary to keep top 12 inches (300 mm) below finish grade.
4. For inside corners, bend panel. For outside corners, cut core to provide 3 inches (75 mm) for overlap.

B. Fill to Grade: Place native fill material over **drainage panels**. Place material in loose-depth layers not exceeding 6 inches (150 mm). Thoroughly compact each layer. Fill to finish elevations and slope away from building.

3.5 PROTECTION AND CLEANING

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071326

SECTION 071413 - HOT FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Reinforced waterproofing membrane – horizontal applications. complete including Hot Rubberized Asphalt Waterproofing and Pavers
   2. Concrete surface conditioner,
   3. rubberized asphalt waterproofing membrane and flashing,
   4. protection course,
   5. insulation,
   6. EVFM leakage test system installed integrally with waterproofing

B. Related Sections include the following:

   1. Division 32 Section Unit Pavers for pavers to be installed as part of this system under single source responsibility for this work.
   2. Division 7 Section "Joint Sealants" for joint-sealant materials and installation.
   3. Division 7 Section for Air Barriers
   4. Division 32 Sections for Soil, Plants and Irrigation Systems

1.3 PERFORMANCE REQUIREMENTS

A. Provide waterproofing that prevents the passage of water and complies with physical requirements in CAN/CGSB-37.50, "Hot Applied, Rubberized Asphalt for Roofing and Waterproofing."

1.4 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties.

B. LEED Submittals: Submit information required for the following
   1. Credit MR 4: Materials and Resources - Recycled Content.
   2. Credit MR 5: Materials and Resources - Regional Materials.

C. Performance Data is REQUIRED for the products included in this section:
   1) Fluid applied membrane roofing system shall be ENERGY STAR® compliant (highly reflective) AND high emissivity roofing (emissivity of at least 0.9 when tested in accordance with ASTM 408)

3. Certification from an approved independent testing laboratory experienced in testing this type material, that the material meets CSGB-37.50-M89 standard for rubberized asphalt membranes, including applicable ASTM procedures, 25% post consumer recycled rubber content and inert clay fillers. Testing shall be done by Ortech Environmental or other national testing laboratory acceptable to the Architect.
4. Certification and description of the full time quality control/quality assurance program of production facilities responsible for the manufacture of the rubberized asphalt and that each batch of material is tested to insure conformance with the manufacturer's published physical properties. The quality assurance program description shall include all methods of testing for physical and mechanical property values. Provide confirmation of manufacturer's certificate of analysis for reporting the tested values of the actual material being supplied for the project prior to issuance of the specified guarantee.
5. The plant manufacturing the rubberized asphalt material shall have ISO 9001-2000 approval as evidenced by a notarized copy of the official certificate
6. Letter from the proposed primary membrane manufacturer confirming that proposed membrane manufacturer has been producing rubberized asphalt membrane products in the North America for a minimum of 15 years without a change in the basic product design, e.g. no substantive changes product composition, polymer specification, asphalt and filler formulation.
7. List of 3 of the proposed primary membrane manufacturer's projects, located in the State of Utah, of equal size and degree of difficulty which have been performing successfully for a period of at least 15 years. Provide current phone contacts of Architects and Owners for verification.
8. Letter from the proposed primary membrane manufacturer's Director of Technical Services confirming that the proposed waterproof membrane and flashing components meet or exceed ALL the physical and mechanical requirements listed in Part 2 of this specification.
9. Certification showing that all membrane components are being supplied and warranted by a single-source manufacturer.
10. Certification showing that all components of the green roof assembly are being supplied and warranted by a single source manufacturer.
11. Evidence that the waterproof membrane assembly is currently Class A listed with Underwriters Laboratories.
12. Evidence that the waterproof membrane assembly is currently listed as a Class 1 Roof Cover with Factory Mutual Research Company Standard 4470 listing or equivalent for the proposed membrane system. The waterproof membrane configuration shall be approved by FM for Class 1-SH (severe hail) exposure. The roof configuration (including insulation, etc.) shall be approved by FM for minimum 1-90 wind uplift construction when required.
13. Product Data for each type of waterproofing specified including manufacturer's printed instructions for evaluating, preparing and treating the substrate, technical data and tested physical performance.
14. Provide product data on all components of the green roof assembly including manufacturer's printed instructions for evaluating, preparing and treating substrate, technical data and tested physical performance.
15. Provide evidence that the waterproofing membrane is resistant to salt water when tested in accordance with ASTM D-896.
16. Provide evidence that the waterproofing membrane is resistant to fertilizer when tested in accordance with ASTM D-896.
17. Provide evidence that the waterproofing membrane is resistant to a three year exposure to animal waste.

C. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions.

1. Include Setting Drawings showing layout, sizes, sections, profiles, and joint details of concrete pavers with paver support assemblies.

D. Samples: For the following products:

1. 12-by-12-inch (300-by-300-mm) square of flashing sheet.
2. 4-by-4-inch (100-by-100-mm) square of drainage panel.
3. Paver pedestal assembly.

E. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

1. Letter from the proposed primary membrane manufacturer confirming that the bidder is an acceptable Contractor authorized to install the proposed system and has been an approved installer of the system for ten (10) continuous years.

F. Product Test Reports: From a qualified independent testing agency indicating and interpreting test results of waterproofing for compliance with requirements, based on comprehensive testing of current waterproofing formulations.

G. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who is authorized, approved, or licensed to install waterproofing manufacturer's products; and who is eligible to receive waterproofing warranty specified.

1. Contractor Qualifications: Company specializing in performing the work of this section with at least 10 continuous years documented experience and certified by the membrane manufacturer.
   a. Certification:
   b. Certification or licensing shall have been in effect continuously for at least ten (10) years prior to bidding on this Project.
   c. Certification or licensing shall qualify for manufacturer's premium labor and material warranty.
2. Contractor shall have at least ten years experience in installing materials specified and shall have successfully completed at least three projects of similar scope and complexity in the state of Utah. Provide current phone contacts of Architects and Owners for verification.
   a. Contractor Certification: Obtain written certification from manufacturer of rubberized asphalt waterproofing system certifying that Contractor is approved by manufacturer for installation of specified membrane system. Provide copy of certification to Architect prior to award of waterproofing work.
   b. Contractor's Field Supervision: Installer must maintain full-time supervisor/foreman on jobsite during times that waterproofing work is in progress.
   c. Manufacturer's Field Supervision: The manufacturer shall maintain supervision of the work and have a full time representative witnessing the work in progress on a weekly basis (different time of day each week so that all parts of the work can be inspected), with a minimum of 8 hours per week.
3. Contractor shall designate a single individual as project foreman who shall be on site at all times during installation. Foreman shall be employed by the Contractor for ten (10) years and have ten (10) years experience installing the specified product. Contractor shall designate key personnel of the on-site crew who shall be experienced in work of the

type specified. Neither the foreman nor the key personnel shall be changed without the Architect's consent.

B. Membrane Manufacturer Qualifications
   1. The rubberized asphalt membrane product shall contain inert clay fillers and crumb rubber to enable to product to be resistant to acids (fertilizers, building washes and acid rain) and maintain membrane thickness during application. This content shall be certified by a report from Ortech Environmental or other independent testing laboratory approved by the architect.
   2. The rubberized asphalt membrane product shall contain a minimum of 25% reclaimed rubber.
   3. Membrane manufacturer shall have an in-house technical staff to assist the contractor, when necessary, in application of the product and final inspection of the assembly.
   4. Membrane Manufacturer Qualification: Manufacturer shall demonstrate qualifications to supply materials of this section by certifying the following:
      a. Membrane Manufacturer must show evidence that the specified rubberized asphalt has been manufacturer by the same source for fifteen (15) years and successfully installed on a yearly basis for a minimum of fifteen (15) years on projects similar in scope and complexity.
      b. Membrane Manufacturer must not issue warranties for terms longer than they have been manufacturing the hot fluid applied asphalt membrane.

C. Source Limitations: Obtain waterproofing materials, sheet flashings, protection course, and drainage panels through one source from a single manufacturer.

D. Mockups: Apply waterproofing to 100 sq. ft. (9.3 sq. m) of deck to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality. Install pavers and paver supports to demonstrate aesthetic affects and quality of materials and execution.

   1. If Architect determines mockups do not comply with requirements, reapply waterproofing until mockups are approved.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review requirements for waterproofing, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below 0 deg F (minus 18 deg C).

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Written warranty, signed by waterproofing manufacturer agreeing to repair or replace waterproofing and sheet flashings that do not comply with requirements or that do not remain watertight within specified warranty period.

1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/8 inch (3 mm) in width.
2. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.
3. Warranty Period: 10 years after date of Substantial Completion.

B. Special Installer's Warranty: Written waterproofing Installer's warranty, signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Approval of the manufacturers from catalog information indicates brand name and general characteristics are acceptable to the Architect, **but does not relieve the Contractor of the responsibility of providing material and accessories equal to or better than what is specified and shown on the drawings**. Manufacturers are limited to the following:

1. American Hydrotech, Inc.; Monolithic Membrane 6125.
2. Carlisle Corporation, Carlisle Coatings & Waterproofing Div.; CCW-500.
3. Permaquick PQ6100

2.2 MEMBRANE

A. Single-component; 100 percent solids; hot fluid-applied, rubberized asphalt with the following properties and contains 25% post consumer recycled content, inert clay fillers measured per applicable test methods in CAN/CGSB-37.50:

1. Flash Point: Not less than 260 deg C or not less than 25 deg C above manufacturer's maximum recommended application temperature.
2. Cone Penetration: 110 maximum at 25 deg C, and 200 maximum at 50 deg C.
3. Flow: 3 mm maximum at 60 deg C.
4. Toughness: Not less than 5.5 J
5. Ratio of Toughness to Peak Load: Not less than 0.040.
6. Adhesion Rating: Pass.
7. Water-Vapor Permeance: 1.7 ng/Pa x s x sq. m.
8. Water Absorption: 0.35-g maximum mass gain, or 0.18-g maximum mass loss.
9. Pinholing: Not more than one pinhole.
10. Low-Temperature Flexibility: No cracking.
11. Crack Bridging Capability: No cracking, splitting, or loss of adhesion.
12. Heat Stability: Comply with requirements for penetration, flow, low-temperature flexibility, and viscosity when heated for five hours at manufacturer's recommended application temperature.
13. Viscosity Test: 2 to 15 seconds.
14. Resistance to Fertilizer ASTM D-896 similar undiluted 15/5/5 nitrogen/ phosphorus/ potash: No delamination, blistering, emulsification or deterioration
15. Resistance to Animal Waste 3-year exposure: no deterioration
16. Specific Gravity: 1.23 ± .02

2.3 AUXILIARY MATERIALS

A. Primer: ASTM D 41, asphaltic primer.

B. Elastomeric Flashing Sheet: 50-mil- (1.3-mm-) minimum, nonstaining, uncured sheet neoprene with manufacturer's recommended contact adhesives and predrilled metal termination bars and anchors, with the following physical properties as measured per standard test methods referenced:

1. Tensile Strength: 1400 psi (9.6 MPa) minimum; ASTM D 412, Die C.
2. Elongation: 300 percent minimum; ASTM D 412.
3. Tear Resistance: 125 psi (860 kPa) minimum; ASTM D 624, Die C.
4. Brittleness: Does not break at minus 30 deg F (34 deg C); ASTM D 2137.

C. Modified-Bituminous Flashing Sheet: SBS-modified bituminous sheet, 160-mil- (4-mm-) thick, woven or nonwoven polyester or glass-fiber reinforced; suitable for application method specified; granular surfaced.

D. Sealants and Accessories: Waterproofing manufacturer's recommended sealants and accessories.

E. Reinforcing Fabric: Manufacturer's recommended spun-bonded polyester fabric.

F. Separator Sheet: ASTM D 4397, polyethylene sheet, minimum 4 mils (0.10 mm) thick.

G. Protection Course: Semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:

1. Thickness: 1/8 inch (3 mm), nominal, for vertical applications; 1/4 inch (6 mm), nominal, elsewhere.
2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for type of protection course.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve laminated to 1 side of a 3-dimensional, nonbiodegradable, molded-plastic-sheet drainage core, with a horizontal flow rate not less than 2.8 gpm per ft. (35 L/min. per m) .

2.5 PLAZA DECK PAVERS

A. Plaza Deck Pavers: Concrete pavers in Division 32 Section **are the responsibility of this Section.**

B. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of 1/8 inch (3 mm).

1. Concrete Fill: ACI 301, compressive strength of 5000 psi (34 MPa) at 28 days and air content of 6 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Proceed with installation only after unsatisfactory conditions have been corrected

B. Technical Start-up. The primary membrane manufacturer shall provide a technical start-up for the waterproofing application. A technical representative from the membrane manufacturer will review the following items with the installer prior to commencement of the installation of the membrane:
1. Substrate conditions
2. Substrate moisture tests
3. Application techniques
4. Develop methods of thickness control that include the following:
   a. Poundage of material used versus area covered (LB/SF) figured for fabric reinforced method of application.
   b. Gridded deck method of application.
   c. Establish minimum thickness.
   d. Establish procedures and frequency for spot-checking thickness with a thickness gauge.

3.2 PREPARATION

A. Clean and prepare substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.
   1. Substrate Tests:
      a. Test substrate for moisture according to ASTM D-4263-83(93). Apply an 18" x 18" piece of 4 mil plastic to the floor when dry, tape down with 2" duct tape, leave for at least 16 hours, then remove plastic and examine. If moisture exists on the underside of the plastic or on the surface of the concrete, there is moisture in the concrete and the test will need to be performed until the substrate passes.
      b. Test adhesion of membrane to substrate using manufacturer's recommended test method or as otherwise directed by the Architect.
   2. Surface Contaminants:
      a. Verify that form release agents used on vertical surfaces are compatible with membrane products.
      b. Verify that no membrane-forming curing compounds were used on horizontal or other surfaces.
      c. Where curing compounds or incompatible form release agents have been used, remove by blast cleaning down to sound, clean substrate. Acid etching is not acceptable.
   3. Do not begin installation until mechanical and electrical items that penetrate membrane are complete and approved.
      a. Verify items which penetrate surfaces to receive membrane are securely installed and comply with the manufacturers requirements

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

   1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.

E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.3 JOINTS, CRACKS, AND TERMINATIONS

A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to CAN/CGSB-37.51, "Application of Rubberized Asphalt, Hot-Applied, for Roofing and Waterproofing," and waterproofing system manufacturer's written instructions.

   1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.

2. Adhere elastomeric flashing sheet to substrate in a layer of hot, rubberized asphalt. Extend elastomeric flashing sheet a minimum of 6 inches (150 mm) on each side of joints and cracks and beyond deck drains, corners, and penetrations.
3. Embed reinforcing fabric into a layer of hot, rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches (150 mm) on each side of joints and cracks and beyond deck drains, corners, and penetrations.

B. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric flashing sheet extended a minimum of 6 inches (150 mm) on each side of joints and adhere to substrates in a layer of hot, rubberized asphalt.

3.4 FLASHING INSTALLATION

A. Install flashing sheets at terminations of waterproofing membrane according to CAN/CGSB-37.51, "Application of Rubberized Asphalt, Hot-Applied, for Roofing and Waterproofing," and waterproofing system manufacturer's written instructions.

B. Prime substrate with asphalt primer.

C. Install elastomeric flashing sheet and adhere to deck and wall substrates in a layer of hot, rubberized asphalt.

D. Install modified-bituminous flashing sheet and adhere to substrate in a layer of hot, rubberized asphalt.

E. Extend flashing sheet up walls or parapets a minimum of 8 inches (200 mm) above plaza deck pavers and 6 inches (150 mm) onto deck to be waterproofed.

F. Install termination bars and mechanically fasten to top of flashing sheet at terminations and perimeter of roofing.

3.5 MEMBRANE APPLICATION

A. Apply rubberized asphalt according to CAN/CGSB-37.51, "Application of Rubberized Asphalt, Hot-Applied, for Roofing and Waterproofing," and manufacturer's written instructions.

B. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for heating rubberized-asphalt waterproofing.

C. Start application with manufacturer's technical representative present.

D. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow to dry.

E. Reinforced Membrane: Apply waterproofing to substrates and adjoining surfaces indicated. Spread hot fluid-applied, rubberized asphalt to a thickness of 90 mils (2.3 mm); embed reinforcing fabric, overlapping sheets 2 inches (50 mm); and spread another 125-mil- (3.2-mm-) thick layer to provide a uniform, reinforced, seamless membrane 215 mils (5.5 mm) thick.

F. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer. 225 mils thick.

G. Cover waterproofing with separator sheet with overlapped joints while rubberized asphalt is still hot and before membrane is subject to traffic.

1. Install protection course with overlapped joints over separator sheet.

3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels to substrate according to manufacturer's written instructions. Use adhesives that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.7 FIELD QUALITY CONTROL

A. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of sheet flashings.
2. Flood each area for 48 hours or minimum as required by manufacturer for approval.
3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

B. Engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

C. Testing:

1. EFVM® testing is required for all horizontal plaza and roof slab areas. For areas to receive EFVM® testing provide the following:

2. Thoroughly wet the waterproofing membrane in area of test. Wetting can be accomplished by hand or mechanical spray devises. Membrane must be wet during the testing procedures. Ponded water is not necessary.

3. Place the Vector-9 conductor wire on wetted, bare membrane. Secure wire with small strips of waterproofing or other compatible membrane or tape. Overburden, insulation, drainage composites and filter fabric shall not be installed prior to the initial test

4. Allow the testing technician to locate membrane breaches, if any.

5. Visually inspect entire membrane area and repair all breaches found.
6. Document location of breaches found by the EFVM® test and visual inspections.

3.8 CURING, PROTECTING, AND CLEANING

A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.

1. Do not permit foot or vehicular traffic on unprotected membrane.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction

C. Membrane must be protected immediately following subsequent membrane repairs and EFVM® test.

D. Once membrane testing is conducted and all repairs are complete, the membrane shall be immediately protected with drainage composite and insulation.

E. Eliminate construction traffic on newly tested membrane systems. Do not store construction materials on unprotected membrane surfaces.

F. Trafficking or storing materials on the tested membrane can introduce additional damage to the waterproofing system and will nullify the testing procedures.

G. Any membrane that is observed to be trafficked or used as a storage/working platform must be retested and immediately repaired and covered with insulation and drainage composite.

END OF SECTION 071413

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes warranted clear water-repellent coatings for the following surfaces:

1. Brick surfaces.

B. Related Sections include the following:

1. Division 4 Section for unit masonry.
2. Division 7 Section "Joint Sealants" for joint sealants.

1.3 PERFORMANCE REQUIREMENTS

A. Provide water repellents with the following properties based on testing manufacturer's standard products, according to test methods indicated, applied to substrates simulating Project conditions using same materials and application methods to be used for Project.

1. Absorption: Minimum 90 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.

2. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.
3. Water Penetration and Leakage through Masonry: Maximum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.
4. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 53.
5. Permeability: Minimum 80 percent breathable in comparison of treated and untreated specimens, per ASTM D 1653.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's specifications, surface preparation and application instructions, recommendations for water repellents for each surface to be treated, and protection and cleaning instructions. Include data substantiating that materials are recommended by manufacturer for applications indicated and comply with requirements.

B. Samples: Of each substrate indicated to receive water repellent, 12 inches (300 mm) square, with specified repellent treatment applied to half of each sample.

C. Applicator Certificates: Signed by manufacturer certifying that the applicator complies with requirements.

D. Certification by water repellent manufacturer that products supplied comply with local regulations controlling use of VOCs.

E. Material Test Reports: Indicate and interpret test results for compliance of water repellents with requirements indicated.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who employs only persons trained and approved by water repellent manufacturer for application of manufacturer's products.

B. Testing Agency Qualifications: An independent testing agency with experience and capability to conduct testing indicated in "Performance Requirements" Article without delaying the Work, per ASTM E 548.

C. Field Samples: Architect will select one representative surface for each substrate to receive water repellents. Apply water repellent to each substrate, with either partial or full coverage as directed. Comply with application requirements of this Section.

1. Obtain Architect's approval of field samples before applying water repellents.
2. Maintain field samples during construction in an undisturbed condition as a standard for judging the completed Work.

1.6 PROJECT CONDITIONS

A. Weather and Substrate Conditions: Do not proceed with application of water repellent under any of the following conditions, except with written instruction of manufacturer:

1. Ambient temperature is less than 40 deg F (4.4 deg C).
2. Mortar has cured for less than 28 days.
3. Rain or temperatures below 40 deg F (4.4 deg C) are predicted within 24 hours.
4. Application is earlier than 24 hours after surfaces have been wet.
5. Substrate is frozen or surface temperature is less than 40 deg F (4.4 deg C).
6. Windy condition exists that may cause water repellent to be blown onto vegetation or surfaces not intended to be coated.

1.7 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty, executed by the applicator and water repellent manufacturer, covering materials and labor, agreeing to repair or replace materials that fail to provide water repellency within the specified warranty period. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and

treated substrate, formation of new joints and cracks in excess of 1/16 inch (1.5 mm) wide, fire, vandalism, or abuse by maintenance equipment.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Veneer areas - Silane/ Siloxane Blends or Siloxanes With 3.3 lb/gal. (400 g/L) VOCs or less. (Contractor verify VOC compliance)

   a. AquaTrete Chem-Trete Inc.
   b. Prime-A Pell H2O = Chemprobe Technologies.
   c. Hydropel, Hydrozo, BASF
   d. Weatherseal Siloxane WB (for brick), and Weatherseal Natural Stone Treatment (for stone); Prosoco, Inc. (Design Standard)

2.2 WATER REPELLENTS

A. Silane/Siloxane Blends: Consisting of silanes and siloxanes blended to achieve a particular penetration and protection on a specific substrate.

B. Proprietary Blends: Consisting of one or several different resins (silanes, siloxanes, or acrylics), polymers, stearates, or oils plus other compounds or products of components.

C. VOC Compliance: Products to be provided must comply with current VOC regulations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to repellent manufacturer's written instructions, to ensure surface is sufficiently dry.

B. Test for pH level, according to water repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.

C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.

D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

E. Test Application: Before performing water-repellent work, including bulk purchase and delivery of products, prepare a small application in an unobtrusive location and in a manner approved by Architect to demonstrate the final effect (visual, physical, and chemical) of planned application. Proceed with work only after Architect approves test application or as otherwise directed.

1. Revisions of planned application, if any, as requested by Architect, will be by Change Order if they constitute a departure from requirements of Contract Documents at the time of contracting.

3.2 APPLICATION

A. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.

B. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized technical service representative to inspect and approve the substrate before application and to instruct the applicator on the product and application method to be used.

B. Utilize Rylem Tube testing before and after application to establish protection provided by product application in accordance with warranty requirements as specified. Record results and report to Architect.

1. Testing by manufacturers representative shall be scheduled within 24 hours after application to permit additional coats if required prior to final cure of repellant system.

3.4 CLEANING

A. Protective Coverings: Remove protective coverings from adjacent surfaces and other protected areas.

B. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation for foundations
2. Glass-fiber blanket insulation for stud spaces
3. Loose-fill insulation.
4. Mineral wool insulation for filling cavities adjacent to glazing and frames.
5. Vapor Retarders

B. Related Sections:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.

2. Division 04 Section "Unit Masonry" for insulation installed in **cavity walls and** masonry cells. Installed as work of masonry.
3. Division 06 Section "Sheathing" for board sheathing over steel framing.
4. Division 07 Section(s) "**ThermoPlastic Roofing”** for insulation specified as part of roofing construction.
5. Division 07 Section "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.
6. Division 09 Section(s) "**Gypsum Board Shaft Wall Assemblies**" for installation in metal-framed assemblies of insulation specified by referencing this Section.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: Provide layout for vapr retarder, include details of penetrations and system transitions and terminations.
   1. Vapor tight fixtures or treatments that create air-tight conditions are required for all assemblies penetrating the vapor barrier assembly.
   2. Provide product data of acceptable performance of all penetrations.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

E. Research/Evaluation Reports: For foam-plastic insulation, from **ICC-ES**.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Installer qualifications for Spray Foam Materials and application: Comply with CAN/ULC S705.1-1 and S7-05.2-05

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

   1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
   3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM BOARD INSULATION

A. Exterior Insulation: Glass-fiber-reinforced enhanced polyisocyanurate foam core sheathing faced with embossed aluminum or glass facing on each face , complying with ASTM C1289 and meeting the following physical properties:

   1. ASTM C1289 Type 1, Class 2
   2. Compressive Strength (ASTM D1621): 20 psi, minimum.
   3. Aged Thermal Resistance (ASTM C518, measured at Mean Temp of 75F): R-6.5 at 1 inch thickness
   4. Flexural Strength (ASTM C203): Minimum 40 psi.
   5. Water Absorption (ASTM C209): Maximum.1.0 percent by volume.
   6. Water Vapor Permeance (ASTM E96): <1.0 perms.

7. Maximum Use Temperature: 250 degrees F.

B. Acceptable Products: include, but are not limited to, the following:

The Dow Chemical Company "THERMAX™ ci Exterior Insulation."
Hunter Panels Xci CG

Thickness and Stabilized R-Value: Nominal 0.625 inch thickness 2 inch thickness, R-12.0

C. Mechanical Fasteners: Type recommended by insulation board manufacturer for application indicated.

2.2 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
3. Johns Manville.
4. Knauf Insulation.
5. Owens Corning.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.

2.3 MINERAL-WOOL BOARD INSULATION

A. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. Fibrex Insulations Inc.
2. Isolatek International.
3. Owens Corning.
4. Roxul Inc.
5. Thermafiber.

B. Unfaced, Mineral-Wool Board Insulation: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).

2.4 MINERAL-WOOL BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. Fibrex Insulations Inc.
2. Owens Corning.
3. Roxul Inc.
4. Thermafiber.

B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.5 VAPOR RETARDERS

A. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 22 lb/1000 sq. ft. (10 kg/100 sq. m), with maximum permeance rating of 0.1317 perm (7.56 ng/Pa x s x sq. m) and with flame-spread and smoke-developed indexes of not more than 5 and 60, respectively, per ASTM E 84.

1. Products: Subject to compliance with requirements, **available products that may be incorporated into the Work include, but are not limited to, the following**:

a. Raven Industries Inc.; DURA-SKRIM 2FR.
b. Reef Industries, Inc.; Griffolyn T-55 FR.

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

D. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.

E. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation **or vapor retarders, including removing projections capable of puncturing vapor retarders,** or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

E. All types of insulation require airtight finished installation, installed tightly to fit all substrate and wall conditions. Joints sealed and complete.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical footing and foundation wall surfaces, set insulation units **using manufacturer's recommended adhesive** according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of **36 inches (915 mm)** below exterior grade line.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face, or in serpentine pattern over air barrier and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

B. Protect adjacent materials from contact with adhesive. Clean or replace affected materials immediately when unintentional contact occurs.

3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

D. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.

E. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

2. Pack area with mineral wool insulation to push Vapor retarder tight to supporting construction for air-tight final assembly.

3.6 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend insulation 48 inches (1219 mm) up either side of partitions.

3.7 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
2. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.

3.8 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation. The vapor retarder shall form a continuous, air-tight membrane at the interior of the exterior envelope. The vapor retarder shall be continuous and flash in to wall openings, and the roof vapor retarder.

B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
   1. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
   2. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

   1. All penetrations including, but not limited to, electrical boxes, conduit, fire extinguisher cabinets shall be air–tight where used in conjunction with wall and ceiling penetrations to maintain the continuous vapor barrier system.

D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

E. Where adjacent construction will not permit access to adequately seal vapor retarder, force safing insulation into the space, pushing Vapor Retarder tight into space, held in place with wire retainer.

3.9 PROTECTION

A. Protect installed insulation **and vapor retarders** from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Fluid-applied membrane air and weather barrier, vapor permeable.
   2. Transition flashings, edge membranes and sealants to provide complete air and water tight assemblies within parameters of specified performance requirements.

B. Related Sections include the following:
   1. Division 04 Section "Unit Masonry" for embedded flashings.
   2. Division 06 Section "Sheathing" for wall sheathings, wall sheathing joint-and-penetration treatments, building paper, and building wraps.
   3. Division 07 Section "Thermal Insulation" for foam-plastic board insulation.
   4. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal flashings.
   5. Division 07 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 DEFINITIONS

A. ABAA: Air Barrier Association of America.

B. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PERFORMANCE REQUIREMENTS

A. General: : Air barrier shall be capable of performing as a continuous vapor-**retarding permeable** air barrier **and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration**. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air Permeance of Air Barrier Materials: Not to exceed **0.004 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft. when tested in accordance with ASTME2178**

C. Air Permeance of Air Barrier Materials: Not to exceed **0.004 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft. when tested in accordance with ASTM E2357**

1.5 PRECONSTRUCTION TESTING

A. Mockup Testing: Air barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. Owner will engage a qualified testing agency.
2. Qualitative Testing: Mockups will be tested for evidence of air leakage according to **ASTM E 1186, smoke pencil with pressurization or depressurization ASTM E 1186, chamber pressurization or depressurization with smoke tracers** and **ASTM E 779**
3. Notify Architect **seven** days in advance of the dates and times when mockup testing will take place.
4. Installation must be accepted on Mock-up before starting installation on structure.

1.6 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. LEED Submittal:

1. Product Data for Credit MR 4 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

C. Shop Drawings: Show locations and extent of air barrier as indicated on drawings and as specified. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1. Include details of interfaces with other materials that form part of air barrier.
2. Include details of mockups.

D. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.

E. Qualification Data: For Applicator.

F. Qualification Data for Manufacturer: showing proof of manufacturer of air barrier a minimum of five years.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.7 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance **and that is an ABAA-licensed contractor, employs certified and registered installers, and complies with ABAA's Quality Assurance Program**]

B. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.

1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
2. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
3. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
4. Mock ups will be constructed with all wall systems intended for use on the project including block and steel stud walls with respective exterior cladding.

C. Preinstallation Conference: Conduct conference at Project site.

1. Include installers of other construction connecting to air barrier, including roofing, waterproofing, masonry, sealants, windows, glazed curtain walls, and door frames.
2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.10 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace air barrier that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Manufacturing defects.
b. Loss of performance properties as stated in manufacturers published product data.

2. Material Warranty Period: **2** years from date of Substantial Completion,

B. Special Project Warranty: Installer's Warranty, signed by Installer, covering the Work of this Section, in which Installer agrees to repair or replace components of air barrier installation that fail to achieve air and water tight seals and loss of cohesion or adhesion including interfaces with adjoining systems within specified warranty period. Remedial repair, materials and staff to achieve specified performance requirements are required as part of the work.

1. Warranty Period: **Two** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER

A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Synthetic Polymer Membrane:

1) Henry Company; Air-Bloc **31**.
2) WR Meadows, AirShield **LMP**
3) Carlisle CCW

2. Physical and Performance Properties:

a. Membrane Air Permeance: Not to exceed **0.004 cfm/ sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa)** pressure difference; ASTM E 2178.
b. Membrane Vapor Permeance: Not less than **11 perms** ASTM E 96.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of air barrier material.

C. Counterflashing Strip: Modified bituminous, 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 32 mils (0.8 mm) of rubberized asphalt laminated to an 8-mil- (0.2-mm-) thick, crosslaminated polyethylene film with release liner backing.

D. Butyl Strip: Vapor-retarding, 30- to 40-mil- (0.76- to 1.0-mm-) thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.

E. Modified Bituminous Strip: Vapor-retarding, 40-mil- (1.0-mm-) thick, smooth-surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

F. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.

G. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

H. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

I. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft (24 to 32 kg/cu. m) density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

J. Joint Sealant: Butyl or ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, as recommended by manufacturer, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Division 07 Section "Joint Sealants." Must be acceptable to manufacturer selected.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of preparation coat strip extending a minimum of 3 inches (75 mm) along each side of joints and cracks. Apply a double thickness of air barrier membrane and embed a joint reinforcing strip in preparation coat.

B. Gypsum Sheathing: Fill joints greater than 1/8 inch (3 mm) with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Apply primer at joints. Tape joints with joint reinforcing strip after primer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

A. Install strips, transition strips, supporting angles, flexible sheets and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install **butyl** strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over both substrates.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials **as required**.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply **transition strip or sheet** so that a minimum of 3 inches (75 mm) of coverage is achieved over both substrates. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames with not less than 1 inch (25 mm) of full contact.

1. **Adhesive** Transition Strip: Roll firmly to enhance adhesion.
2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches (150 mm) o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings to air barrier with an additional 6-inch-(150-mm-)wide, **counterflashing** strip.

J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in all directions.

3.5 AIR BARRIER MEMBRANE INSTALLATION

A. Apply air barrier membrane to form a complete envelope seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

C. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

D. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties and penetrations

1. Vapor-Permeable Membrane Air Barrier: 90-**mil wet film thickness minimum unless otherwise recommended by air barrier manufacturer to comply with requirements.**

E. Apply **strip and transition strip over cured air membrane overlapping 3 inches (75 mm) onto each surface** according to air barrier manufacturer's written instructions.

F. Seal top edge of air barrier to roof membrane and other materials to form a complete exterior envelope closure as indicated on drawings or modified as recommended by air barrier manufacturer to provide air-tight performance.

G. Seal air barrier to glazing systems framing including windows, curtainwall and storefront, in accordance with manufacturers written instructions.

H. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

I. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided and are
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed for airtight performance

C. Tests: Testing to be performed will be determined by Owner's testing agency from among the following tests:

1. Qualitative Testing: Air barrier assemblies will be tested for evidence of air leakage according to **ASTM E 1186, smoke pencil with pressurization or depressurization** or **chamber pressurization or depressurization with smoke tracers**.
2. Quantitative Air Leakage Testing: Testing not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage according to **ASTM E 783**.

D. Remove and replace deficient air barrier components and retest as specified above.

3.7 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than **60 d**ays.
2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 074123 – METAL SOFFIT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Factory-formed and field-assembled, concealed-fastener, nesting seam flush faced metal panels.

B. Related Sections include the following:

1. Division 5 Section "Cold-Formed Metal Framing" for framing supporting metal panels.
2. Division 7 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.3 DEFINITION

A. Metal Panel Assembly: Metal panels, attachment system components, miscellaneous metal framing and closure trim, and accessories necessary for a complete system.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):

a. Trim and closures.

C. Coordination Drawings: Elevations drawn to scale and coordinating penetrations and -mounted items. Show the following:

1. panels and attachments.
2. **Stud framing**.

D. Samples for Initial Selection: For type of metal panel indicated with galvanized finish.

1. Include similar Samples of trim and accessories.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain metal panels through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal panels.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage. Penetrating water that causes staining on surface of galvanized panels will be cause for rejection of panels.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify locations of structural members and opening dimensions by field measurements before metal panel fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming of panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.8 COORDINATION

A. Coordinate metal panel assemblies with construction of s**tuds,** and other adjoining work to provide a secure installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including rupturing, cracking, or puncturing.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: **Two** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Steel sheet metallic coated by the hot-dip process.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

2.3 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL PANELS

A. Refer to Division 7 Section "Building Insulation."

2.4 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, and other suitable fasteners designed to withstand design loads. Provide

1. Fasteners for Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws.
2. Fasteners for Closures and Trim: Blind fasteners or self-drilling screws with hex washer head.
3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

2.5 CONCEALED -FASTENER, NESTING-SEAM METAL PANELS

A. General: Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required including edge trim and base closures.

B. Flush faced, Concealed-Fastener Metal Panels: Formed with 12 inch wide face with nesting lap seam male and female receiver along each side of panel.

1. Manufacturers include but are not limited to the following:

a. ATAS International OPF-8 Panel – smooth faced without grooves

2. Material: Zinc-coated (galvanized) steel sheet, **0.0217 inch (0.55 mm) 26 gauge** thick.

a. Exterior Finish: Fluoropolymer

2.6 ACCESSORIES

A. Panel Accessories: Provide components required for a complete metal panel assembly including trim, sills, corner units, clips, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels, unless otherwise indicated.

B. Trim: Formed from 0.0187-inch- thick,28 gauge, zinc-coated (galvanized) steel sheet. Provide trim as required to provide finished appearance. Locations include, but are not limited to, bases, sills, jambs, corners, framed openings, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

2.7 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile for full length of panel.

C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2.8 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA **2604**.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of work.

1. Examine framing to verify that studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before metal panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Miscellaneous Framing: Install base angles, sills, furring, and other miscellaneous panel support members and anchorage according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION, GENERAL

A. General: Install metal panels in orientation, sizes, and locations indicated on Drawings. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal panels by torch is not permitted.
2. Shim or otherwise plumb substrates receiving metal panels.

3. Rigidly fasten base end of metal panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
4. Flash and seal metal panels with closures at perimeter of all openings. Fasten with self-tapping screws.
5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Install trim as metal panel work proceeds.
7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
8. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
9. Align bottom of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.

B. Fasteners:

1. Steel Panels: Use galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal panel manufacturer.

3.4 FIELD-ASSEMBLED METAL PANEL INSTALLATION

A. Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
2. Locate and space exposed fasteners in uniform vertical and horizontal alignment.
3. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
4. Provide sealant tape at lapped joints of metal panels and between panels and protruding equipment, vents, and accessories.
5. At panel splices, nest panels with minimum 6-inch (150-mm) end lap

3.5 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building to provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel assembly including trim, flashings, gaskets, fillers, closure strips, and similar items.

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074123

SECTION 074243 - ALUMINUM COMPOSITE WALL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes aluminum composite material fabricated into soffit, coping and trim for the Entrance Canopy
   1. Wet type joints with sealant seams routed and returned at panel edges
   2. Extruded aluminum panel support system.
   3. Flashings and accessories

B. Related Sections: The following sections contain requirements that relate to this Section:

   1. Division 7 Section "Joint Sealants" for field-applied sealants.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Provide wall system that complies with air infiltration and water penetration performance requirements indicated without the reliance of a secondary backup membrane.

B. Air Infiltration: Provide wall systems with an air infiltration rate of not more than 0.06 cfm per sq. ft. of fixed wall area when tested in accordance with ASTM E 283 at a static air pressure differential of 1.57 psf.

C. Water Penetration: Provide wall systems with no water penetration as defined in the test method when tested in accordance with ASTM E 331 at an inward static air pressure differential of not less than 15.0 psf.

D. Bond Integrity: Provide wall system with no loss of bond strength or delamination when tested in accordance with the following:

   1. Bond Strength: 861 psi (5941 kPa) minimum in accordance with ASTM C 297-88.
   2. Peel Strength: 22.5 lb/in. (0.4 kg/cm) minimum in accordance with ASTM D 1781-76, or 20 lb/in. (0.35 kg/cm) minimum in accordance with ASTM D 903.
   3. In addition, the panels should remain intact with no decrease in bond strength after 8 hours in 212 deg F. (100 deg. C) water, and 21 consecutive days immersed in 70 deg. F. (20 deg. C) water.

E. Structural Performance of Wall System: Provide wall system capable of withstanding the effects of all loads integral to itself and elements attached to it or supported by it, including all gravity loads in combination with the following horizontal loads. Member design and connections shall be based on the worst combination of gravity and any single horizontal load.

1. Structural Performance Testing: Wall system shall be tested in accordance with ASTM E 330-84 at design pressure. Deflection of horizontal perimeter framing members normal to the plane of the wall between supports shall not exceed L/240 of the span length or 1/2-inch, whichever is less. After initial test, test at 150 percent of design pressure. No permanent deformation exceeding L/1000 or failure to structural members allowed.
2. Wind Loads: As required by IBC for Wind Design, but not less than that indicated by the General Structural Notes, applied perpendicular to the face of the wall panel, acting inward or outward.
3. Seismic Loads: Loads required by IBC, (both perpendicular to and parallel with the plane of the wall, but not simultaneously).

F. Thermal Movements: Provide wall system that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing displacement of panels, opening of joints, overstressing of components, failure of joint sealants and connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

F. Vertical Building Movement (Floor and/or Roof Live Load deflection): Design and detail system(s) to allow for live load deflections of at least L/360 for typical spandrel beam locations.

G. Building Attachments: Design all connection materials, fasteners, welds, anchors and embedded items as required to attach the wall system to the building as required by IBC and structural calculations.

H. Design wall system and connection to building structure to withstand loads and movements without exceeding allowable stresses established by the following:

1. For Structural Steel: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."
2. For Cold-Formed Steel: AISI SG-673, Part I, "Specification for the Design of Cold-Formed Steel Structural Members."
3. For Aluminum: AA ADM-1, "The Aluminum Design Manual."

I. Coordination: Wall systems shall be designed and detailed with due consideration for, and fully coordinated with, all interfacing materials, elements, and systems and their respective attachments and movements.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data including manufacturer's product specifications, system details meeting project design requirements, certified product test reports showing compliance with performance requirements, installation instructions, and general recommendations, as applicable to materials and finishes for each component and for total panel system.

C. Samples for verification purposes of wall panels. Provide sample panels 12 x 12 inches in the color indicated.

D. Shop Drawings showing layouts of panels, details of edge conditions, joints, corners, panel profiles, supports, anchorages, trim, flashings, closures, and special details. Distinguish between factory and field assembly work.

E. Calculations prepared by a Utah Licensed Professional Engineer responsible for or having direct supervision over the production of calculations, and any other item or issue pertinent to the wall panel system design.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed ACM wall system projects similar in material, design, and extent to that indicated for this Project and with a 10 year record of successful in-service performance.

B. Fabricator Qualifications: A firm experienced in producing ACM wall systems similar to those indicated for this Project and with a 10 year record of successful in-service performance, as well as sufficient production capacity to produce required panels.

C. Single-Source Responsibility for Fabrication and Installation: Engage a qualified fabrication/installation firm to assume undivided responsibility for fabricating and installing ACM wall systems specified in this Section.

D. Product Options: Drawings are diagrammatic only and intended to indicate scope, profiles, system arrangements, and dimensional requirements of the ACM wall system required and are based on the specific system specified.Responsibility for watertight performance and engineering is that of the Contractor, fabricator and manufacturer.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance and design requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Fire-Test-Response Characteristics: Provide materials and construction identical to those of assemblies tested for fire resistance per tests indicated by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Flame Spread: 25 maximum per ASTM E84, and no flame spread along interior face of penetration through the wall assembly per IBC standards.
2. Smoke Developed: 450 or less per ASTM E84.
3. Flaming: No surface flaming per ASTM E 162.
4. Ignition Temperature: Greater than 650 deg. F, in accordance with ASTM D 1929.

F. ICBO Research Report: Aluminum composite material manufacturer shall have a current ICBO research report allowing its use on non-combustible construction, and shall have established a Certification Program acceptable to authorities having jurisdiction.

G. Mockups: Before installing wall panels, construct mockups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using exposed and concealed materials including air barriers, indicated for the completed Work.

1. Locate mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build mockups for the following kinds of ACM wall system:

    a. Wall system corresponding to area indicated on Drawings, showing typical components, connections, attachments to building structure, and methods of installation.

3. Notify Architect 7 days in advance of the dates and times when mockups will be constructed.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before proceeding with construction of wall panels.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

    a. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver panels and other components so they will not be damaged or deformed. Package wall panels for protection against transportation damage.

B. Handling: Exercise care in unloading, storing, and erecting wall panels to prevent bending, warping, twisting, and surface damage.

1. Remove and replace damaged items as directed.

C. Store materials at protected location at building site under cover away from other construction activities to avoid damage. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal wall panels so that they will not accumulate water. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

1.7 PROJECT CONDITIONS

A. Established Dimensions: Establish and coordinate wall construction to ensure actual locations of structural members and to ensure opening dimensions correspond to established dimensions.

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal wall panels within the specified warranty period and agreeing to repair finish or replace wall panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.

C. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ALUMINUM COMPOSITE MATERIAL WALL SYSTEM FABRICATORS

A. Manufacturer: Subject to compliance with requirements, provide wall panels by one of the following:

1. Composite Aluminum Wall Panel Systems:

a. Elward Systems Corporation Alucobond RR -1, Rout and Return Wet System.
b. Dunmon Corporation Universe 2000, Rout and Return Wet System.
c. Copper Sales, Inc, Una-Clad 1000, Rout and Return Wet System.

2.2 ALUMINUM COMPOSITE MATERIAL

A. Composite Aluminum Material : Aluminum alloy face sheets applied under tension to both sides of a extruded, fire rated, thermoplastic core in a continuous process with no glues or adhesives between the materials.

1. Total ACM Thickness: 4mm (0.157 inch) minimum.
2. Aluminum Face Sheets: 0.0197-inch (0.50mm) thick aluminum type 3003 or 3105-H25 alloy for coil coated sheet.

B. Manufacturer: Subject to compliance with requirements, provide aluminum composite material by one of the following:

1. Aluminum Composite Material:

a. Alucobond 21; Alusuisse Composites, Inc.
b. Alpolic FR; Mitsubishi Chemical America, Inc.
c. Reynobond FR; Reynolds Metals Co.

2.3 WALL SYSTEM MOUNTING MATERIALS AND ACCESSORIES

A. Aluminum: Alloy and temper recommended by wall system fabricator and finisher for type of use and finish indicated and with not less than the strength and durability of alloy and temper designated below:

1. Aluminum Sheet Prepainted with Coil Coating: Aluminum sheet complying with ASTM B 209 (ASTM B 209M) for alclad alloy 3003, 3004, or 3105-H25 with temper as required to suit forming operations, prepainted by the coil-coating process

2. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063-T52, with a minimum thickness of 0.080 inch (2.0 mm) for primary legs of extrusions.

c. Finish: Mill finish where not exposed to view in completed Work, black finish where exposed to view.

B. Flashing: 0.060 inch (1.5 mm) thick aluminum, finished to match wall system.

C. Fasteners: Aluminum or stainless steel, self-tapping hexhead type screws designed to withstand design loads.

1. Provide exposed fasteners with heads matching color of wall system by means of factory-applied coating.

D. Elastomeric Sealant: Medium-modulus neutral-curing silicone sealant complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."

1. Color to match Architects sample. May be custom with some manufacturers.

E. Accessories: Unless otherwise specified, provide components required for a complete wall system assembly including weatherstripping, internal guttered weep system, mounting accessories, reveals, trim, clips, stiffeners, copings, corners, flashings, and similar items. Match materials and finishes of panels.

F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat, unless otherwise indicated. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.5 ALUMINUM FINISHES

A. High-Performance Organic Coating Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

1. Fluoropolymer 3-Coat Coating System: Coil coated Kynar 500 or Hylar 5000, 3-coat, thermocured system composed of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluorocarbon topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight; complying with AAMA 605.2-92 and the following:
   a. Humidity Resistance: No formation of blisters when subjected to condensing water fog at 100 percent relative humidity and 100 deg. F. For 3000 hours in accordance with ASTM D 2247.
   b. Salt Spray Resistance: Complying with the following when tested in accordance with ASTM B 117 exposing coating system to 3000 hours, using a 5 percent NaC1 solution:

      1) Corrosion creepage from scribe line: 1/16 inch (1.6 mm) maximum.
      2) Minimum blister rating of 8 within the test specimen field.

   c. Outdoor Weather Exposure: Comply with the following after 5 year exposure at 45 degree angle facing south Florida exposure:

1) Maximum color change of 5 Delta E units as calculated in accordance with ASTM D 2244.
2) Maximum chalk rating of 8 in accordance with ASTM D 659.
3) No checking, crazing, adhesion loss.

2. Color: Silver to duplicate brushed anodized aluminum finish.

2.6 COMPOSITE PANEL WALL SYSTEM FABRICATION

A. General: Fabricate rout and return wet joint aluminum composite material wall system with all components and accessories as required to fulfill design intent and indicated performance requirements. Fabricate ACM wall system and accessories at the shop to greatest extent possible.

B. Wall System: 2-inch nominal thickness system composed of a aluminum composite material surface mounted on aluminum extrusion shapes.

1. Form aluminum composite material with routed and returned edges forming a pan-type panel assembly anchored sealants into custom mounting extrusions forming rout and return wet type joint with edges of ACM and aluminum plate protected within the continuous joint pocket.
2. Fabricate wall system joints with nominal 3/8-inch wide reveals.
3. Provide continuous extruded aluminum mounting and indexing extrusions mechanically fastened to the aluminum composite material panel.

C. Fabricate wall system components to allow for field adjustment and thermal movement.

D. Square and trim edges of sheet with no displacement of aluminum sheets or protrusion of core material.

E. Form panel lines, breaks, and angles to be sharp and true, with surfaces that are free from warp or buckle.

F. Fabricate Panel surface with grain pattern of finish running in same direction throughout wall system.

G. Where required for structural performance, shop apply extruded aluminum stiffeners with structural silicone adhesive to the back of the composite panels and aluminum plate panels to maintain flatness of the panel. Attach stiffeners in a manner that will not interfere with or restrain free differential thermal movement of the panel.

H. Where welding is required to provide configurations indicated, weld joints and seams continuously at back of panels. Provide smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

1. Use welding procedures that will blend with and not cause discoloration of metal being joined.

I. Apply bituminous coating or other permanent separation materials on concealed panel surfaces where panels would otherwise be in direct contact with substrate materials that are non-compatible or could result in corrosion or deterioration of either material or finishes.

J. Fabrication Tolerances: Fabricate wall system to comply with the following:

1. Panel Bow: 0.8 percent maximum of panel overall dimension in width and length.
2. Panel lines, breaks, and curves shall be sharp, smooth, and free of warps and buckles.
3. Surface Flatness: Fabricate panels with a flatness deviation not to exceed 0.030 inch in 18 feet (0.14 mm per meter) in any direction when measured with a metal straight edge.
4. Dimensional Variation: As follows:

    a. Panel Width: Plus or minus 1/32 inch (0.8 mm) maximum.
    b. Panel Length: Plus 0 inch (0 mm), minus 1/8 inch (3.0 mm) maximum.
    c. Panel Thickness: Plus or minus 1/32 inch (0.8 mm) maximum.

K. Panel system to be field sealed with backer rod between panels with silicone materials as specified in Division-7.

2.7 SECONDARY FRAMING

A. Panel Supports and Anchorage: Provide structural studs, girts, furring channels, angles, plates, bracing, and other secondary framing members to receive and support panels where required to connect nominal 2-inch panels to building structure.

B. Bed panel supports in self adhering sheet compatible with air barrier to maintain performance of air barrier system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements indicated for conditions affecting performance of manufactured wall panels.

1. Do not proceed with wall panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate metal wall panels with flashing, trim; and construction of soffits, roofing, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

B. Secondary Structural Supports: Install structural studs, girts, angles, and other secondary structural panel support members and anchorages where required to reach and connect to building structural frame members provided for wall system support.

3.3 PANEL INSTALLATION

A. General: Comply with manufacturers' instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the work securely in place, with provisions for thermal and structural movement.

1. Install wall system with concealed fasteners.

B. Erect and securely anchor wall system components plumb, level, square, and true to line and complying with the following tolerances:

1. Installation Tolerances: Shim and align panel units within installed tolerance of 1/8 inch in 12'-0" on vertical and horizontal line of any member, or 1/4-inch in any total run in any line.

C. Accessories: Install components and accessories required for a complete wall system assembly including mounting accessories, reveals, trims, flashings, formed aluminum shapes, and similar items.

D. Joint Sealers: Provide joint sealants within wall system and between wall system and adjacent surfaces as required for a complete, weathertight assembly. Do not substitute sealants for dry-gasketed type joints within wall system.

1. Install sealants and backer rod in accordance with manufacturer s instructions, including requirements for joint width to depth ratios and substrate priming as applicable.

E. Separate dissimilar metals by painting each metal surface in area of contact with a bituminous coating or by other permanent separation as recommended by manufacturers of dissimilar metals.

F. Promptly remove protective film from exposed surfaces of wall system after completion of wall system. Strip with care to avoid damage to finish.

3.4 FIELD QUALITY CONTROL

A Testing Agency: Engage a qualified independent testing agency to perform testing indicated.

B Water Spray Test: Test system for water penetration according to AAMA 501.2 in a 2-bay area directed by Architect.

C Repair or remove Work that does not meet requirements or that is damaged by testing; replace to conform to specified requirements.

3.5 CLEANING AND PROTECTION

A. Clean integral gutters and weep system to assure functioning weep system at time of Substantial Completion.

B Provide final protection and maintain conditions, in a manner acceptable to fabricator and Installer, that ensure wall system is without damage or deterioration at the time of Substantial Completion.

END OF SECTION 074243

SECTION 075419 – POLYVINYL CHLORIDE MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Mechanically fastened PVC membrane roofing system over insulated steel deck.
   2. Roof insulation of thicknesses required to achieve R-60 rating unless otherwise noted.
   3. Ballasted installation at low Roof Areas on Building 2.
   4. Vapor Retarder – Self adhering, self healing to serve as Air Barrier for the roof assembly.
   5. Substrate board required for wind warranted assembly.
   6. 30 year NDL DFCM warranty. With 30 year Wind Warranty
   7. Clipping of fasteners where exposed to view.

B. Roof work shall be constructed to be free of non-draining areas, with positive slope to drain, under all conditions. Acceptance by the manufacturer of such standing water areas, low spots, wrinkles or other conditions that retain water under their existing guidelines shall have no bearing on the Architect or Owner's requirements to accept conditions that are deemed not to be acceptable. Such defects that create areas not suited to free drainage shall be cause for rejection of the installation until corrected.

   1. Factory fabricated components may require modification to achieve positive drainage, to comply with specific project requirements for dimensional limitations and slopes to drain.

C. Related Sections include the following:

   1. Division 01 Section "Sustainable Design Requirements" for MR Credit 4
   2. Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
   3. Division 7 Section "Building Insulation" for insulation beneath the roof deck.
   4. Division 7 Section for Air Barriers
   5. Division 7 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings and rain drainage.
   6. Division 7 Section "Joint Sealants."
   7. Division 23 Section "Plumbing Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

B. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.

C. Factored Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," after multiplication by a safety factor.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; that remain airtight and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. FMG Listing: Provide roofing membrane, base flashings, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.

Fire/Windstorm Classification: Class 1A-105

D. LEED Credit SS 7.2: Roof Membrane shall have a SRI minimum of 78.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Insulation fastening patterns.
4. Roof sump detail showing coordination with roof drains.
5. Air Tight roof membrane integration with adjacent building and air barrier components.

C. Samples for Verification: For the following products:

1. 12-by-12-inch (300-by-300-mm) square of sheet roofing, of color specified, including T-shaped side and end lap seam.
2. 12-by-12-inch (300-by-300-mm) square of roof insulation.
3. 12-inch (300-mm) length of metal termination bars.
4. 12-inch (300-mm) length of battens.
5. Six insulation fasteners of each type, length, and finish.
6. Six roof cover fasteners of each type, length, and finish.

D. LEED Submittals: indicating Solar Reflective Index of 78 or more.

E. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

F. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of meeting performance requirements.

G. Qualification Data: For Installer and manufacturer.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.

I. Research/Evaluation Reports: For components of membrane roofing system.

J. Maintenance Data: For roofing system to include in maintenance manuals.

K. Warranties: Special warranties specified in this Section.

L. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty prior to receipt of bids.
1. A minimum of two years experience is required on similar sized projects.

B. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain components for membrane roofing system from or approved by roofing membrane manufacturer.

D. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

E. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site. Comply with requirements for preinstallation conferences in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following:

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review conditions of sloped deck and tapered insulation to confirm that no flat spots exist in the installation.
6. Review structural loading limitations of roof deck during and after roofing.
7. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
8. Review requirements to maintain a continuous plane iof air barrier tightness at transitions between roofing and adjacent components.
9. Review governing regulations and requirements for insurance and certificates if applicable.
10. Review temporary protection requirements for roofing system during and after installation.
11. Review roof observation and repair procedures after roofing installation.

F. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer’s form without monetary limitation (NDL) where manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.

1. Warranty Period: 30 years from date of Substantial Completion, with 90 mph Wind rating.

B. Special Project Warranty: Submit roofing Installer's warranty, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders and walkway products, for the following warranty period:

1. Warranty Period: FIVE years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 ROOFING MEMBRANE

A. Fabric-Reinforced PVC Sheet: Uniform, flexible sheet reinforced internally and as follows:

Manufacturers:

Carlisle SureFlex.
Duro-Last Roofing, Inc., PVC.
Sarnafil, Inc S-327 PVC.
Versico Versiflex.

Thickness: 80 mils, nominal thickness .

Exposed Face Color: White.

2.3 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, **Type X, 5/8 inch (16 mm)**] thick.

1. Products: Subject to compliance with requirements, **available products that may be incorporated into the Work include, but are not limited to, the following**:

a. Georgia-Pacific Corporation; Dens Deck.

b. USG Securock Gypsum Fiber Roof Board

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.4 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane.

C. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as sheet membrane.

D. Bonding Adhesive: Manufacturer's standard bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings.

E. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

F. Metal Battens: Manufacturer's standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch (25 mm) wide by 0.05 inch (1.3 mm) thick, prepunched.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

2.5 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.

1. Available Manufacturers include the following:

a. AlliedSignal Inc.; Commercial Roofing Systems.
b. Atlas Roofing Corporation.
c. Carlisle SynTec Incorporated.
d. Firestone Building Products Company.
e. Hunter Panels, LLC.
f. Johns Manville International, Inc.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to a minimum slope of **3/8 inch per 12 inches or as required to provide a minimum slope of 1/4 inch per 12 inche**s in valleys. EPS is NOT permitted in sloped applications.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric mat, water permeable and resistant to ultraviolet degradation, type and weight as recommended by roofing system manufacturer for application.

D. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application to separate membrane from insulating substrate

2.7 VAPOR RETARDER

A. SBS modified self adhering sheet: 32 mil thickness minimum, with maximum permeance rating of 0.17 perm (0.92 ng/Pa x s x sq. m).

2.8 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, open-grid, surface-textured, flexible PVC walkway mat, approximately 9/16 inch thick, and acceptable to membrane roofing system manufacturer.

1. Color: Gray.
2. Size: 24 x 24 squares or 3 foot wide by 33 feet long rolls.
3. Design Standard: Design Standards are used to establish a level of quality for the work. Premium products equal in quality of acceptable manufacturers may be used. The use of a Design Standard is not to be construed as a limit of competition or a constraint of trade.

    a. Sarnafil Crossgrip Walkway Mat.

    b. Carlisle ECO NOVA

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
2. Verify that pressure treated wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck comply with requirements in Division 5 Section "Steel Deck."
4. Verify that membrane shows no signs of abrasion, discoloration, or defects.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

D. Employ roofer for repairing existing roof membrane as approved by the manufacturer, where warranties are still in effect for the existing assembly.

3.3 VAPOR-RETARDER INSTALLATION

A. Self Adhering sheet Place self adhering sheet in a single layer over area to receive vapor retarder, side lapping each sheet a minimum of 3 inches Stagger end laps a minimum of 12 inches.

1. Continuously seal side and end laps by rolling with roller to ensure adhesion to deck

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system and provide air-tight performance.

C. Extend vapor retarder up parapets and lap behind PVC base flashing. Fully adhere to parapet

D. Repair all punctures and tears, prior to covering retarder sheet with insulation.

3.4 SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

3.5 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install MULTIPLE layers of insulation, joints staggered, under area of roofing to achieve required thickness.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Field rim factory formed units where required to provide slopes in crickets and drains.

G. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

H. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type. Offset joints between layers.

1. Fasten insulation according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification to a true 90 mph wind load
2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

3. Where fasteners are exposed to the building interior, clip shaft of fastener to project 1 inch from roof deck.

3.6 MECHANICALLY FASTENED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over steel deck areas to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.

1. Install sheet according to ASTM D 5082.

B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing membranes and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.

E. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

F. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.

G. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring. Add second ply where drains are set after membrane installation.

H. In-Splice Attachment: Secure one edge of roofing membrane using fastening plates or metal battens centered within membrane splice and mechanically fasten roofing membrane to roof deck. Field-splice seam.

I. Clip fasteners to project 1 inch from underside of deck.

3.7 LOOSELY LAID AND BALLASTED MEMBRANE ROOFING INSTALLATION

A. Loosely lay membrane roofing over area to receive roofing and install according to roofing system manufacturer's written instructions.

B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically fasten or adhere perimeter of membrane roofing according to requirements in SPRI RP-4.

E. **Mechanically fasten** membrane roofing at corners, perimeters, and transitions according to requirements in SPRI RP-4.
   1. At corners and perimeters, adhere a second layer of membrane roofing.
   2. Fully adhere membrane to top of rough carpentry.

F. Apply membrane roofing with side laps shingled with slope of deck where possible.

G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

   1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
   2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
   3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

I. Install protection mat over membrane roofing, overlapping a minimum of 6 inches (150 mm). Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of 12 inches (300 mm).

J. Aggregate Ballast: Apply uniformly over membrane roofing at the rate required by membrane roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to membrane roofing system. Lay ballast as membrane roofing is installed, leaving membrane roofing ballasted at the end of the workday.
   1. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m).

3.8 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with sheet flashing.

D. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 WALKWAY MAT INSTALLATION

A. Flexible Walkway Mats: Install walkway mat products in locations indicated, from hatches to roof-top mounted equipment. Secure to roofing membrane according to roofing system and walkway mat manufacturers' written instructions.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

1. Notify Architect or Owner 48 hours in advance of date and time of inspection.

C. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

WARRANTY FOR SINGLE PLY ROOFING

WHERE AS,_____(manufacture name), a corporation whose address is, _____ hereinafter called the Manufacturer, has manufactured and sold and caused to have applied, pursuant to the specifications and inspection, the necessary roofing materials to construct a PVC, TPO, EPDM or other single ply roof of approximately _____square feet and associated roof flashing of approximately _____ linear feet on the building described below:

OWNER: STATE OF UTAH

Owner:State of Utah

DFCM Project Number:_____

Building Name:_____

Location:_____

Date of Acceptance of Roofing:_____

Manufacturer Address:_____

Manufacturer's Warranty No:_____

Phone Number for Warranty Services:_____

Roofing Contractor Name:_____

Roofing Contractor Address:_____

AND WHEREAS, by careful examination of said roof by the Manufacturer's representative, it has been determined that roofing materials have been applied in conformance with Manufacturer's specifications.

AND WHEREAS, Manufacturer represents and wishes to warranty, subject to the limits stated herein, that its roofing when so applied is effectively watertight for a period of thirty (30) years despite normal wear and tear by the elements, as well as guaranteeing it against defects in workmanship or materials.

NOT withstanding any other provision herein, this warranty shall not cover damages related to winds in excess of _____ miles per hour

NOW THEREFORE, said Manufacturer warranties to the said Owner that, as set forth below, during a period of thirty (30) years from the date of acceptance of said single-ply roofing described above, Manufacturer will at its own expense, make or cause to be made, any repairs that may be necessary, as a result of defects in workmanship or materials supplied by the Manufacturer which results in leaks or of normal wear and tear by the elements which results in leaks, and will maintain said roof in water tight condition free from all leaks arising from such causes. For purposes of this warranty, damage to the roof caused by any unusual natural phenomena shall not be deemed to be "normal wear and tear by the elements".

INCLUSIONS: This Warranty does cover, and Manufacturer shall be liable for the following:

1. Roofing membrane, membrane flashings, metal flashings, mechanical fastening system, anchors, adhesives, seaming materials, slip sheets, fabrics, insulations, under payments, and accessories furnished by the Manufacturer as incorporated into the roof membrane system.

2. Vapor barriers, insulations and / or materials furnished by the Manufacturer or approved to be incorporated into the roof membrane assembly and such damage as may result from failure of these materials.

3. Repair of splits, breaks, cracks, and seam failures in membrane system.

4. Leaks from failure in material or workmanship.

EXCLUSIONS: This Warranty does not cover, and Manufacturer shall not be liable for the following:

1. Metal work, including metal counter flashings, not a part of the roof membrane system and such damage as may result from application of these materials;

2. Any damage to the roof caused by structural defect in, or failure of, the building or defects in, or failure of, any structural roof deck, or other sheathing materials, used as the base over which the roof and roof insulation is applied;

3. Roof damage from special chemical conditions not disclosed to Manufacturer;

4. Any damage to the building or contents thereof, except replacement of damaged roof insulation and vapor barrier as noted under "INCLUSION" above;

5. Damage due to unauthorized alterations to roofing system.

6. Damage to the roof due to mechanical abrasion or abuse not caused by the Manufacturer.

7. Damage or failure directly caused by the re-use of existing material. (re-roof)

8. Reasonable care and maintenance will be the responsibility of the owner.

INSPECTION AND REPAIR: During the term of this Warranty, Manufacturer, its agents or employees, shall have free access to the roof during regular business hours. Upon verbal notice by Owner to Manufacturer within four days of the discovery of any leaks in the roofing system, or need of repair of roof, the Manufacturer shall have ten (10) days to inspect the roof. Following such inspection:

1. Manufacturer, at its own expense shall make such repairs as are required by this warranty.

2. In case owner or his agent has verbally notified Manufacturer that repairs are required and such repairs are not covered by the Warranty (including repairs required by owner's alteration, extension or addition to the roof) Manufacture, after having obtained Owner's consent thereto, in writing, shall make or cause to be made, such repairs at Owner's expense in accordance with specifications and procedures as established by Manufacturer and this warranty shall thereupon remain in effect for the un-expired portion of its original term. If Owner fails to so consent or if repairs are made by one other than the Manufacturer's authorized designee, this Warranty with respect to such area shall be automatically terminated.

3. In the event the (1) Owner notifies Manufacturer and has confirmed the need of repair of roof and (2) Manufacturer is unable to promptly inspect and repair same, and (3) an emergency condition exists which requires prompt repair in order to avoid substantial damage to owner, then owner may make such temporary repairs as may be essential and any such action shall not be a breach of the provision of this Warranty. Owner will bear emergency repair expenses.

INSPECTION SERVICE: Manufacturer agrees to re-inspect the completed roof not earlier than 18 nor later than 24 months after completion of the roofing, and if it is determined that there are defects in the roofing, then Manufacturer shall make, or cause to be made at its own expense, such repairs as are necessary to remedy said defects within the scope of its responsibility under the terms of this Warranty.

IN WITNESS WHEREOF, Manufacturer has caused this instrument to be signed and sealed by its duly authorized officer this day of _____.

BY: _____

TITLE: _____

CORPORATION: _____

SEAL:

Division of Facilities Construction and Management
Risk I.D. _____

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes sheet metal flashing and trim in the following categories:
   1. Exposed trim, gravel stops, fasciae and copings. In custom colors to match adjacent aluminum storefront and curtainwall framing.
   2. Metal flashing.
   3. Reglets.
   4. Metal flanged bellows type roof expansion assemblies

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5
   2. Division 4 Sections for through-wall flashing and other integral masonry flashings specified as part of masonry and stone work.
   3. Division 5 Section "Expansion Joint Cover Assemblies" for metal expansion-joint covers.
   4. Division 7 Section "Joint Sealants" for elastomeric sealants.
   5. Division 7 Roofing Section for flashing and roofing accessories installed integral with roofing membrane as part of roofing-system work in accordance with requirements of this section.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

B. Fabricate and install flashings at roof edges to comply with recommendations of FM Loss Prevention Data Sheet 1-49 for the following wind zone:

   1. Wind Zone 2: Wind pressures of 31 to 45 psf (1.48 to 2.15 kPa).

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. LEED Submittal:

   1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

D. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.

E. Samples of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.

1. 8-inch- (200-mm-) square Samples of specified sheet materials to be exposed as finished surfaces.
2. 12-inch- (300-mm-) long Samples of factory-fabricated products exposed as finished Work. Provide complete with specified factory finish.

F. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.6 PROJECT CONDITIONS

A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 METALS

A Coil-Coated Galvanized Steel Sheet: Zinc-coated, commercial-quality steel sheet conforming to ASTM A 755, G 90 (ASTM A 755M, Z 275) coating designation, coil coated with high-performance fluoropolymer coating as specified in "Coil-Coated Galvanized Steel Sheet Finish" Article; not less than 0.0336 inch (0.85 mm) thick, unless otherwise indicated.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.

1. Finish: **2D (dull, cold rolled)**.
2. Surface: Smooth, flat

2.2 REGLETS

A. General: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces and compatible with flashing indicated.

B. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

C. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.

D. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of the counterflashing lower edge.

1. Material: coil coated Galvanized steel, 0.0217 inch (0.55 mm) thick.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Fry Reglet Corporation.
2. Hickman: W.P. Hickman Co.
3. Keystone Flashing Company.

2.3 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

B. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coat.

C. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

D. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."

E. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.

F. Roofing Cement: ASTM D 4586, Type I, asbestos free, asphalt based.

2.4 FABRICATION, GENERAL

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Form exposed sheet metal Work that is without excessive/detectable oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

D. Seams: Fabricate nonmoving seams in sheet metal with flat-lock or standing seam

E. Expansion Provisions: Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, or standing seam profile not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

G. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.

1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.5 SHEET METAL FABRICATIONS

A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.

B. Exposed Trim, Gravel Stops, and Fasciae: Fabricate from the following material:
1. Coil-Coated Galvanized Steel: a minimum of 0.0276 inch (0.7 mm) thick. Long span conditions at extended coping cpas may require additional backing or thickness of material.

C. Copings: Fabricate from the following material:
1. Coil-Coated Galvanized Steel: 0.0396 inch (1.0 mm) thick.

D. Base Flashing: Fabricate from the following material:
1. Coil coated Galvanized Steel: 0.0276 inch (0.7 mm) thick.

E. Counterflashing: Fabricate from the following material:
1. Coil coated Galvanized Steel: 0.276 inch (0.55 mm) thick.

F. Flashing Receivers: Fabricate from the following material:
1. Coil coated Galvanized Steel: 0.0396 inch thick.

2.6 COIL-COATED GALVANIZED STEEL SHEET FINISH

A. High-Performance Organic Coating Finish: Apply the following system by coil-coating process on galvanized steel sheet as recommended by coating manufacturers and applicator.

1. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color top-coat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2.
   a. Color and Gloss: A custom color to match Curtainwall for color and gloss

   b. Resin Manufacturers: Subject to compliance with requirements, provide fluoropolymer coating systems containing resins produced by one of the following manufacturers:

      1) Ausimont USA, Inc. (Hylar 5000)
      2) Elf Atochem North America, Inc. (Kynar 500)

2. Coil-Coated Steel Sheet Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

   a. Atas Aluminum Corporation.
   b. Copper Sales, Inc.
   c. MM Systems Corporation.
   d. Petersen Aluminum Corporation.
   e. Vincent Metals.

2.7 BELLOWS-TYPE ROOF EXPANSION ASSEMBLIES

A. Metal-Flanged, Bellows-Type Roof Expansion Assemblies: Provide manufacturer's standard assemblies of sizes and types indicated, with prefabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints, splicing units, adhesives, coatings, and other components as recommended by roof expansion assembly manufacturer for complete installation. Fabricate assemblies specifically for **roof-to-wall curb-to-curb, curb-to-wall** applications.

B. Provide assemblies consisting of exposed polymeric sheet over foam bellows, securely anchored at both edges to 3- to 4-inch- (76- to 100-mm-) wide sheet metal nailing flanges, either flat or angle formed to fit cant or curbs as required. Insulate bellows with closed-cell, flexible rubber or plastic foam not less than 5/16 inch (8 mm) thick; adhere bellows to underside of polymeric sheet.

1. **Available** Manufacturers:

   a. Architectural Art Mfg., Inc.; T Series Roof Expansion Cover.
   b. Balco Metalines, a division of Balco, Inc.; Type .
   c. BMCA Insulation Products, Inc., GAF Materials Corporation; Metalastic.
   d. C/S Group;.
   e. Johns Manville; Expand-O-Flash.
   f. JointMaster, a division of InPro Corporation;
   g. MM Systems Corporation;.
   h. Watson Bowman Acme Corp.;

2. Polymeric Sheet: **Manufacturer's standard Reinforced chlorinated polyethylene, 30 mils (0.8 mm) thick or Chlorosulfonated polyethylene, 36 mils (0.9 mm) thick**.
3. Metal Flanges: **Stainless steel, minimum 0.015 inch (0.4 mm) thick**.

   a. Mortar Flanges: Where flanges will be embedded in concrete or mortar, provide manufacturer's standard perforated-metal mortar flanges.

4. Moisture Barrier: Manufacturer's standard, flexible, continuous, polymeric moisture barrier looped under roof expansion assemblies at locations indicated. **Fill space with blanket-type, mineral-fiber insulation.**
5. Fire Barrier: Provide manufacturer's standard fire barrier.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Verify that all supporting blocking is securely anchored and sloped to provide positive drainage.

3.2 INSTALLATION

A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.

B. Provide high temperature underlayment over the top of blocking, extended down 2 inches minimum on each face.

C. Install exposed sheet metal Work that is without excessive/detactable oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

D. Roof-Edge Flashings: Secure metal flashings at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone. Fasten cleats on sides of parapet away from roof. Use neoprene fitted screws for anchoring flashings on roof side of parapet.

E. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.

1. Use joint adhesive for nonmoving joints specified not to be soldered.

G. Seams: Fabricate nonmoving seams in sheet metal with standing seams as shown. Tin edges to be seamed, form seams, and solder on non-prefinished material only.

H. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
1. Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.

I. Install reglets to receive counterflashing according to the following requirements:
1. Where reglets occur in masonry, furnish reglets for installation under Division 4 Section "Unit Masonry."

J. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 inches (50 mm) and bed with sealant.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Roof Hatch

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.
2. Division 6 Section "Rough Carpentry" for wood cants, and wood nailers.
3. Division 7 Section PVC roofing for Vapor retarder and membrane roofing system.
4. Division 7 Section "Sheet Metal Flashing and Trim" for shop- and field-fabricated metal flashing and counterflashing, roof expansion-joint covers and miscellaneous sheet metal trim and accessories.
5. Division 7 Sections for roofing accessories included as part of roofing Work.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.

B. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other Work.

1. Show integration with vapor retarder underlayment to maintain air tight performance.

D. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

E. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for roof accessories with factory-applied color finishes.

F. Samples for Verification: For each type of exposed finish required, prepared on Samples in manufacturer's standard sizes, and of same thickness and material indicated for the Work. If finishes involve normal color or shade variations, include sample sets showing the full range of variations expected.

1.4 QUALITY ASSURANCE

A. Standards: Comply with the following:

1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

B. Air Permeance: Not to exceed **0.004 cfm x sq. ft. of surface area at 75 Pa. when tested in accordance with ASTM E 2357.**

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work are limited to, the following:

a. Babcock-Davis Hatchways, Inc.
b. Bilco Company.
c. O'Keeffe's Inc.
d. ThyCurb, Inc.
e. Wasco Products, Inc.

2.2 MATERIALS, GENERAL

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M) for alclad alloy 3005H25 or alloy and temper required to suit forming operations, with mill finish, unless otherwise indicated.

B. Extruded Aluminum: ASTM B 221 (ASTM B 221M) alloy 6063-T52 or alloy and temper required to suit structural and finish requirements, with mill finish, unless otherwise indicated.

C. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M with Class AZ-50 (AZ-150) coating, structural quality, Grade 40 (Grade 275), or as required for strength.

D. Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of thickness indicated.

E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for above-ground use, complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

F. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other non-corrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

1. Where removing exterior exposed fasteners affords access to building, provide nonremovable fastener heads.

G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

H. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coating.

I. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

J. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.

K. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.3 ROOF HATCH

A. General: Fabricate units to withstand 40-lbf/sq. ft. (1.9- kPa) external and 20-lbf/sq. ft. (0.95-kPa) internal loading pressure. Frame with minimum 9-inch- (225-mm-) high, integral-curb, double-wall construction with 1-1/2-inch (38-mm) insulation, formed cants and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints. Provide double-wall cover (lid) construction with 1-inch- (25-mm-) thick insulation core. Provide gasketing and equip with corrosion-resistant or hot-dip galvanized hardware including pintle hinges, hold-open devices, interior padlock hasps, and both interior and exterior latch handles.

1. Provide a unit for

B. Type: Single-leaf personnel access.

1. For ladder Access: 36 by 36 inches, unless otherwise indicated.

C. Material: Aluminum or galvanized steel, or in combination, at Contractor's option.

1. Finish: High-performance organic coating.

2.4 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 COMPONENT FINISHES

A. Galvanized materials - Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

B. Aluminum Finishes - Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. High-Performance Organic Finish regardless of composition: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof airtight and weathertight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.

B. Install roof accessory items according to construction details of NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated,

C. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

D. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

E. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counterflashing). Seal overlap with thick bead of mastic sealant.

F. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.2 CLEANING AND PROTECTION

A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 077200

SECTION 078100 – APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Concealed sprayed fire-resistive materials.

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.
2. Division 5 Section "Structural Steel" for surface conditions required for structural steel receiving sprayed fire-resistive materials.

1.3 DEFINITIONS

A. Concealed sprayed fire-resistive material is applied to surfaces that are concealed from view behind other construction when the Work is completed.

1.4 SUBMITTALS

A. Product Data: For each fire-resistive product specified.

B. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: Structural framing plans indicating the following:

1. Locations and types of surface preparations required before applying sprayed fire-resistive material.

2. Extent of sprayed fire-resistive material for each construction and fire-resistance rating, including the following:

   a. Applicable fire-resistive design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
   b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.
   c. Designation of restrained and unrestrained conditions based on definitions in ASTM E 119, Appendix X3 as determined by a qualified professional engineer.

3. Treatment of sprayed fire-resistive material after application.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Compatibility and Adhesion Test Reports: For primers and other coatings applied to structural steel. Provide reports from a qualified independent testing and inspecting agency engaged by Contractor. Confirm that primers and coatings proposed for application in shop or field are compatible with fire-resistive material. Instruct laboratory to determine compatibility according to requirements specified in "Quality Assurance" Article.

F. Product Test Reports: Indicate that physical properties of proposed sprayed fire-resistive materials comply with specified requirements based on comprehensive testing of current product formulations by a qualified testing and inspecting agency according to requirements specified in "Quality Assurance" Article.

G. Research/Evaluation Reports: Evidence of sprayed fire-resistive material's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: 5 year minimum successful history of installations similar in scope to this Work.

B. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its sprayed fire-resistive materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of sprayed fire-resistive materials that are similar to those indicated for this Project in material, design, and extent.

D. Testing Agency Qualifications: An independent testing and inspecting agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented according to ASTM E 699.

E. Testing of Fire-Resistive Materials: By a qualified testing and inspecting agency engaged by Contractor according to the following requirements:

1. Sprayed fire-resistive materials are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Testing is performed on specimens of sprayed fire-resistive materials that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.
3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.

F. Testing for Compatibility and Adhesion: Engage a qualified testing and inspecting agency to prepare compatibility and adhesion test reports required in "Submittals" Article based on testing that complies with the following requirements:

1. Testing for bond per ASTM E 736 and requirements specified in UL's "Fire Resistance Directory" about coating materials.
2. Verify that manufacturer of fire-resistive material has not found primers or coatings to be incompatible with fire-resistive material based on its own laboratory testing or field experience.

G. Source Limitations: Obtain each type of sprayed fire-resistive material from one source and by a single manufacturer.

H. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials and assemblies identical to those tested for the following fire-test-response characteristics per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify packages (bags) containing sprayed fire-resistive material with appropriate markings of applicable testing and inspecting agency.

1. Fire-Resistance Ratings: As indicated by reference to fire-resistive designs listed in UL's "Fire Resistance Directory," or in the comparable publication of another testing and inspecting agency acceptable to authorities having jurisdiction, for sprayed fire-resistive material serving as direct-applied protection, tested per ASTM E 119.
2. Surface-Burning Characteristics: As indicated for each sprayed fire-resistive product required, tested per ASTM E 84.

I. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR, Part 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; shelf life, if applicable; and fire-resistance ratings applicable to Project.

B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.

C. Store materials inside, under cover, aboveground, so they are kept dry until ready for use. Remove from Project site and discard materials that have deteriorated.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply sprayed fire-resistive material when ambient or substrate temperatures are 40 deg F (4 deg C) or lower, unless temporary protection and heat is provided to maintain temperatures at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of sprayed fire-resistive material. Use natural means or, where this is inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.8 SEQUENCING

A. Sequence and coordinate application of sprayed fire-resistive materials with other related work specified in other Sections to comply with the following requirements:

1. Provide temporary enclosures for interior applications to prevent deterioration of fire-resistive material due to exposure to unfavorable environmental conditions.
2. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
3. Do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
4. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
5. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
6. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, tested, and corrections have been made to defective applications.

PART 2 - PRODUCTS

2.1 CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

A. General: For concealed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated in this Article for material composition and physical properties representative of installed products.

B. Material Composition: as follows:

1. Cementitious sprayed fire-resistive material consisting of factory-mixed, dry formulation of gypsum or portland cement binders and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.

C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property listed as follows:

1. Dry Density: 15 lb/cu. ft. (240 kg/cu. m) for average and individual densities regardless of density indicated in referenced fire-resistive design, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 1 2 -A, Appendix A, "Alternate Method for Density Determination."

2. Thickness: Provide minimum average thickness required for fire-resistive design indicated according to the following criteria, but not less than 0.375 inch (9 mm), per ASTM E 605.

   a. Where the referenced fire-resistive design lists a thickness of 1 inch (25 mm) or greater, the minimum allowable individual thickness of sprayed fire-resistive material is the design thickness minus 0.25 inch (6 mm).
   b. Where the referenced fire-resistive design lists a thickness of less than 1 inch (25 mm) but more than 0.375 inch (9 mm), the minimum allowable individual thickness of sprayed fire-resistive material is the greater of 0.375 inch (9 mm) or 75 percent of the design thickness.
   c. No reduction in average thickness is permitted for those fire-resistive designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft. (240 kg/cu. m).

3. Bond Strength: 150 lbf/sq. ft. (7.2 kPa) per ASTM E 736 under the following conditions:

   a. Field test sprayed fire-resistive material that is applied to flanges of wide-flange structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
   b. If surfaces of structural steel receiving sprayed fire-resistive material are primed or otherwise painted, perform series of bond tests specified in UL's "Fire Resistance Directory" for coating materials.
   c. Minimum thickness of sprayed fire-resistive material tested in laboratory shall be 0.75 inch (19 mm).

4. Compressive Strength: 5.21 lbf/sq. in. (35.9 kPa) as determined in the laboratory per ASTM E 761. Minimum thickness of sprayed fire-resistive material tested shall be 0.75 inch (19 mm) and minimum dry density shall be as specified, but not less than 15 lb/cu. ft. (240 kg/cu. m).
5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
6. Deflection: No cracking, spalling, delamination, or the like per ASTM E 759.
7. Effect of Impact on Bonding: No cracking, spalling, delamination, or the like per ASTM E 760.
8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.27 g/sq. m) in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of sprayed fire-resistive material is 0.75 inch (19 mm), maximum dry density is 15 lb/cu. ft. (240 kg/cu. m), test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.

D. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Flame Spread: 10 or less.
2. Smoke Developed: 0.
3. Fungal Resistance: No observed growth on specimens per ASTM G 21.

E. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cementitious Sprayed Fire-Resistive Material:

a. Pyrolite 15; Carboline Co., Fireproofing Products Div.
b. Monokote Type MK-6; W.R. Grace & Co.--Conn., Construction Products Div.
c. Cafco 300; Isolatek International Corp., Cafco Products.

2.2 AUXILIARY FIRE-RESISTIVE MATERIALS

A. General: Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive materials and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistive designs indicated.

B. Substrate Primers: For use on each substrate , if required, and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:

1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory" for coating materials based on a series of bond tests per ASTM E 736.
2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of sprayed fire-resistive material per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

C. Adhesive for Bonding Fire-Resistive Material: If required, a product approved by manufacturer of sprayed fire-resistive material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, to determine whether they are in satisfactory condition to receive sprayed fire-resistive material. A substrate is in satisfactory condition if it complies with the following:

1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
2. Substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt, or other foreign substances capable of impairing bond of fire-resistive material with substrate under conditions of normal use or fire exposure.
3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.

B. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of oil, rolling compounds, and other substances capable of interfering with bond.

C. Do not proceed with installation of fire-resistive material until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances that could impair bond of fire-resistive material, including oil, grease, rolling compounds, incompatible primers, and loose mill scale.

B. Prime substrates where recommended in writing by fire-resistive material manufacturer, unless compatible shop primer has been applied and is in satisfactory condition to receive fire-resistive material.

C. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application. Provide temporary enclosure as required to confine spraying operations, protect the environment, and ensure maintenance of adequate ambient conditions for temperature and ventilation.

3.3 INSTALLATION, GENERAL

A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to convey and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

B. Apply sprayed fire-resistive material that is identical to products tested as specified in Part 1 in "Product Test Reports" in "Submittals" Article, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.

C. Coat substrates with adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by fire-resistive material manufacturer for material and application indicated.

D. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by fire-resistive material manufacturer, install body of fire-resistive covering in a single course.

E. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by manufacturer.

F. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply sprayed fire-resistive material that differs in color from that of the encapsulant over which it is applied.

3.4 INSTALLING CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

A. Apply concealed fire-resistive material in thicknesses and densities indicated, but not less than those required to achieve fire-resistance ratings designated for each condition, and comply with requirements for thickness specified in Part 2 "Concealed Sprayed Fire-Resistive Materials" Article.

B. Apply water overspray to concealed, sprayed-fiber fire-resistive material as required to obtain designated fire-resistance rating and where indicated.

C. Apply sealer and/or topcoat to concealed sprayed fire-resistive material where indicated.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing and inspecting of completed applications of sprayed fire-resistive material will take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of fire-resistive material for the next area until test results for previously completed applications of fire-resistive material show compliance with requirements.

1. Extent: For each floor area not to exceed 10,000 square feet, on each floor, testing and inspecting agency will evaluate the following characteristics. Tested values must equal or exceed values indicated and values required for approved fire-resistance design.

a. Thickness for Floors, Roofs, and Walls: From the average of 10 measurements from a 144-sq. in. (0.093-sq. m) sample area, with sample width of not less than 6 inches (152 mm) per ASTM E 605.
b. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
c. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 605 or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination."
d. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: Cohesion and adhesion at frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 736.

2. When testing discovers applications of fire-resistive material not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.

C. Remove and replace applications of fire-resistive material where test results indicate that they do not comply with specified requirements for cohesion and adhesion or for density, or both.

D. Apply additional fire-resistive material per manufacturer's written instructions where test results indicate that thickness does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING, PROTECTING, AND REPAIR

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at the time of Substantial Completion.

C. Coordinate application of fire-resistive material with other construction to minimize the need to cut or remove fire protection. As installation of other construction proceeds, inspect fire-resistive material and patch any damaged or removed areas.

D. Repair or replace work that has not been successfully protected.

END OF SECTION 078100

SECTION 078413 - THROUGH-PENETRATION FIRESTOP SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:

1. Walls and partitions.
2. Smoke barriers.

B. The Contractor is responsible for providing code compliant firestop systems complying with Local codes for all penetrations as well as acceptable aesthetic requirements of the Project as established by the Architect where systems are exposed to view.

C. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4.1/4.2 and 5.1/5.2.
2. Division 15 Sections specifying duct and piping penetrations.
3. Division 16 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.

1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems

protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

1. Penetrations located outside wall cavities.
2. Penetrations located in construction containing fire-protection-rated openings.
3. Penetrating items larger than 4-inch- (100-mm-) diameter nominal pipe or 16 sq. in. (100 sq. cm) in overall cross-sectional area.

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

E. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

F. Notwithstanding information noted later in this section, provide materials complying with LEED Credit EQ 4.1

1.4 SUBMITTALS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For penetration firestopping, including printed statement of VOC content and chemical components.

C. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

F. Schedule of Products: Detailed listing of each product and system required for use, based upon project conditions, prepared by Manufacturer and Installer for each condition shown. Indicate code compliance for each product shown.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is qualified by having the necessary experience, staff, and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualification on buyer.

B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is **UL, ITS,** or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:.

   a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
   b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:

      1) UL in "Fire Resistance Directory."
      2) ITS in "Directory of Listed Products."

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hilti Construction Chemicals, Inc.
2. International Protective Coatings Corp.
3. Isolatek International.
4. Nelson Firestop Products.
5. Specified Technologies Inc.
6. 3M Fire Protection Products.
7. Tremco.
8. United States Gypsum Company.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:

   a. Slag-/rock-wool-fiber insulation.

b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.

2.3 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Contractor will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.

1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.

C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Owner of Any Damage."
2. Contractor's name, address, and phone number.

3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

B. In areas exposed to view, label locations shall be determined with care to minimize exposure.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE
FIRESTOP SYSTEMS ARE LISTED USING THE ALPHA-ALPHA-NUMERIC IDENTIFICATION SYSTEM PUBLISHED IN UL'S *FIRE RESISTANCE DIRECTORY*, VOL. 2

TYPE OF PENETRANT	CONSTRUCTION					
	FLOOR PENETRATION SYSTEMS (FIRST ALPHA COMPONENT = C OR F)			WALL PENETRATION SYSTEMS (FIRST ALPHA COMPONENT = C OR W)		
	CONCRETE FLOORS WITH A MINIMUM THICKNESS LESS THAN OR EQUAL TO 5 INCHES	CONCRETE FLOORS WITH A MINIMUM THICKNESS GREATER THAN 5 INCHES	FRAMED FLOORS	CONCRETE OR MASONRY WALLS WITH A MINIMUM THICKNESS LESS THAN OR EQUAL TO 8 INCHES	CONCRETE OR MASONRY WALLS WITH A MINIMUM THICKNESS GREATER THAN 8 INCHES	FRAMED WALLS
NO PENETRATING ITEMS	C-AJ-0001-0999 or F-A-0001-0999	C-BJ-0001-0999		C-AJ-0001-0999, C-BJ-0001-0999, or W-J-0001-0999		W-L-000-1-0999
METALLIC PIPE, CONDUIT, OR TUBING	C-AJ-1001-1999 or F-A-1001-1999	C-BJ-1001-1999, C-BK-1001-1999, or F-B-1001-1999	F-C-1001-1999	C-AJ-1001-1999, C-BJ-1001-1999, or W-J-1001-1999	C-BK-1001-1999 or W-K-1001-1999	W-L-1001-1999
NONMETALLIC PIPE, CONDUIT, OR TUBING	C-AJ-2001-2999 or F-A-2001-2999	C-BJ-2001-2999 or F-B-2001-2999	F-C-2001-2999	C-AJ-2001-2999, C-BJ-2001-2999, or W-J-2001-2999		W-L-2001-2999
ELECTRICAL CABLES	C-AJ-3001-3999 or F-A-3001-3999	C-BJ-3001-3999 or F-B-3001-3999	F-C-3001-3999	C-AJ-3001-3999, C-BJ-3001-3999, or W-J-3001-3999		W-L-3001-3999
CABLE TRAYS WITH ELECTRICAL CABLES	C-AJ-4001-4999 or F-A-4001-4999	C-BJ-4001-4999		C-AJ-4001-4999, C-BJ-4001-4999, or W-J-4001-4999	W-K-4001-4999	W-L-4001-4999
INSULATED PIPES	C-AJ-5001-5999 or F-A-5001-5999	C-BJ-5001-5999	F-C-5001-5999	C-AJ-5001-5999 or W-J-5001-5999		W-L-5001-5999
MISCELLANEOUS ELECTRICAL PENETRANTS	C-AJ-6001-6999 or F-A-6001-6999			C-AJ-6001-6999		W-L-6001-6999
MISCELLANEOUS MECHANICAL PENETRANTS	C-AJ-7001-7999		F-C-7001-7999	C-AJ-7001-7999 or W-J-7001-7999		W-L-7001-7999
GROUPINGS OF PENETRATIONS	C-AJ-8001-8999 or F-A-8001-8999	C-BJ-8001-8999	F-C-8001-8999	C-AJ-8001-8999, C-BJ-8001-8999, or W-J-8001-8999		W-L-8001-8999

For each location where a fire-resistance-rated floor or wall assembly is penetrated, provide a UL-listed through-penetration firestop system selected from the applicable UL number range listed above that complies with Section 078413 - Penetration Firestopping and is suitable for the penetration conditions indicated for the Project.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes sealants for the following applications, including those specified by reference to this Section:

B. This Section includes sealants for the following applications:

1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:
   a. Joints between different exterior materials.
   b. Perimeter joints between exterior materials and frames of doors and windows.
   c. All joints created by new construction
   d. Other joints as indicated.

2. Exterior joints in the following horizontal traffic surfaces:
   a. joints between paving and walks.
   b. Joints between walks and foundation

3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
   d. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   e. All joints created by new construction
   f. Other joints as indicated.

C. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.
2. Division 7 Section "Firestopping" for fire-resistant building joint-sealant systems.
3. Division 8 Section "Glazing" for glazing sealants.
4. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

C. Products listed later in this Section must comply with LEED Credit EQ 4.1

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. LEED Submittal:

1. Product Data for Credit I EQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

2. Product Data for Credit MR 4 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

F. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

H. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

I. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.

J. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
2. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.
3. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F (4.4 deg C).
2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

C. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

D. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified in the sealant schedules at the end of Part 3.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

C. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.4 SOLVENT-RELEASE JOINT SEALANTS

A. Acrylic-Based Solvent-Release Joint-Sealant Standard: Comply with ASTM C 1311 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3.

B. Butyl-Rubber-Based Solvent-Release Joint-Sealant Standard: Comply with ASTM C 1085 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3.

2.5 LATEX JOINT SEALANTS

A. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

2.6 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.7 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Type C: Closed-cell material with a surface skin.
2. Type O: Open-cell material.
3. Type B: Bicellular material with a surface skin typical all exterior building façade joints
4. Type: Any material indicated above.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

    a. Metal.
    b. Glass.
    c. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

F. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.6 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Low-Modulus Nonacid-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: **Available products include the following**

a. 790; Dow Corning.
b. 890; Pecora Corporation.
c. Spectrem 1; Tremco.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50.

4. Additional Movement Capability: **50** percent movement in extension and 50 percent movement in compression for a total of **100** percent movement
5. Use Related to Exposure: NT (nontraffic).
6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

7. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
8. Applications: Control joints in exterior wall system.

B. Neutral one part Medium modulus silicone Sealant: provide products complying with the following:

1. Products: **Available products include the following**

   a. 795; Dow Corning.
   b. 895; Pecora Corporation.
   c. Spectrem II; Tremco.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50.
4. Additional Movement Capability: 25/**50** percent movement
5. Use Related to Exposure: NT (nontraffic).
6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

7. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
8. Applications: flashing set, perimeter of glazing to wall substrates.

C. Mildew-Resistant Silicone Sealant : Where joint sealants of this type are indicated, provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:

1. Products:

   a. 786 Mildew Resistant; Dow Corning.
   b. Sanitary 1700; GE Silicones.
   c. Tremsil 600 White; Tremco.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.

   a. Use O Joint SubstrateS: Porcelain

6. Applications: Interior toilets at fixtures and expansion joints.

D. Pourable Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products:

a. 890-SL; Dow Corning.
b. FC Parking Structure Sealant; Dow Corning.

2. Type and Grade: **S (single component)** and P (pourable).
3. Class: 50.
4. Additional Movement Capability: 100 percent movement in extension and **50** percent in compression for a total of **150** percent movement
5. Uses Related to Joint Substrates: M and, as applicable to joint substrates indicated, O.
6. Applications: Concrete sidewalks, curbs and paving

E. Single-Component Nonsag Urethane Sealant - concealed applications for flashing applications.

1. **Available** Products:

a. Sika Corporation, Inc.; Sikaflex - 1a.
b. Sonneborn, Division of ChemRex Inc.; NP 1.
c. Tremco; Vulkem 116.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

3.7 SOLVENT-RELEASE JOINT-SEALANT SCHEDULE

A. Butyl-Rubber-Based Solvent-Release Sealant : Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: **Available products include the following**

a. Bostik 300; Bostik Inc.
b. PTI 707; H.B. Fuller Company.
c. BC-158; Pecora Corporation.
d. PSI-301: Polymeric Systems, Inc.Sonneborn Multi-Purpose Sealant; Sonneborn Building Products Div., ChemRex, Inc.
e. Tremco Butyl Sealant; Tremco.

2. Applications: Bedding thresholds, concealed joints in flashing systems

3.8 LATEX JOINT-SEALANT SCHEDULE

A. Latex Sealant : Where joint sealants of this type are indicated, provide products complying with the following:

1. Products

a. Chem-Calk 600; Bostik Inc.
b. NuFlex 330; NUCO Industries, Inc.
c. LC 160 All Purpose Acrylic Caulk; Ohio Sealants, Inc.
d. AC-20; Pecora Corporation.
e. PSI-701; Polymeric Systems, Inc.
f. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
g. Tremflex 834; Tremco.

2. Applications: Interior joints in gypsum board applications

END OF SECTION 079200

SECTION 079500 – EXPANSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Architectural joint systems are specified include those scheduled herein and as shown on drawings

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for block-outs and cast-in anchorage and frames for architectural joint systems in concrete floors and walls
2. Division 7 Section "Sheet Metal Flashing and Trim" for roof systems.
3. Division 7 Section "Joint Sealants" for elastomeric sealants and preformed compressed-foam sealants without metal frames.

1.3 DEFINITIONS

A. Architectural Joint System: Any filler or cover used to span, fill, cover, or seal a joint, except expanding foam seals and poured or foamed in-place sealants.

B. Cyclic Movement: Periodic change between widest and narrowest joint widths in an automatically mechanically controlled system.

C. Fire Barriers: Any material or material combination, when fire6 tested after cycling, designated to resist passage of flame and hot gases through a movement joint.

D. Maximum Joint Width: Widest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.

E. Minimum Joint Width: Narrowest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.

F. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage of nominal value of joint width.

G. Nominal Joint Width: Width of linear gap indicated as representing the conditions existing when architectural joint systems will be installed or, if no nominal joint width is indicated, a width equal to the sum of maximum and minimum joint widths divided by two.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide factory-fabricated architectural joint systems capable of withstanding the types of loads and of accommodating the kinds of movement, and the other functions for which they are designed including those specified below, without failure. Types of failure include those listed in Appendix X3 of ASTM E 1399.
   1. Pedestrian Traffic Joints: Support pedestrian traffic across joint.
   2. Exterior Joints: Maintain continuity of weather enclosure.
   3. Joints in Fire-Resistance-Rated Assemblies: Maintain fire-resistance ratings of assemblies.
   4. Joints in Smoke Barriers: Maintain integrity of smoke barrier.
   5. Joints in Acoustically Rated Assemblies: Inhibit passage of airborne noise.
   6. Other Joints: Where indicated, provide joint systems that prevent penetration of water, moisture, and other substances deleterious to building components or content.
   7. Seismic Joints: Remain in place on exposure to seismic activity (movement).
   8. Joints in Surfaces with Architectural Finishes: Serve as finished architectural joint closures.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.

B. Shop Drawings: For each joint system specified, provide the following:

   1. Placement Drawings: Include line diagrams showing entire route of each joint system, plans, elevations, sections, details, joints, splices, locations of joints and splices, and attachments to other Work. Where joint systems change planes, provide Isometric Drawings depicting how components interconnect to achieve continuity of joint covers and fillers.

C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each exposed metal and elastomeric material of joint system indicated.

   1. Include similar Samples of material for joints and accessories involving color selection.

D. Samples for Verification: Full-size units 6 inches (150 mm) long of each type of joint system indicated; in sets for each finish, color, texture, and pattern specified, showing the full range of variations expected in these characteristics.

E. Product Test Reports: From a qualified testing agency indicating architectural joint systems comply with requirements, based on comprehensive testing of current products.

F. Research/Evaluation Reports: Evidence of architectural joint system's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer. Coordinate compatibility with adjoining joint systems specified in other Sections.

B. Fire-Test-Response Characteristics: Where indicated, provide joint systems incorporating fire barriers that are identical to those of assemblies tested for fire resistance per **ASTM E 119 and**

ASTM E 814, including hose-stream test of vertical wall assemblies, by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated. Other manufacturers' systems complying with requirements may be considered. Refer to Division 1 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in Part 2 " Joint Systems" Article.

2.2 MATERIALS

A. Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Strip Seals: Elastomeric membrane or tubular extrusions with a continuous longitudinal internal baffle system throughout complying with ASTM E 1783; used with compatible frames, flanges, and molded-rubber anchor blocks.

C. Compression Seals: Preformed, elastomeric extrusions having internal baffle system complying with ASTM E 1612 in sizes and profiles indicated or as recommended by manufacturer.

D. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint.

E. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.3 JOINT SYSTEMS

A. General: Provide joint systems of design, basic profile, materials, and operation indicated. Provide units with the capability to accommodate joint widths indicated and variations in adjacent surfaces.

1. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials.

2. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
3. Frames for Strip Seals: Designed with semiclosed cavity that provides a mechanical lock for seals of type indicated.
4. Public Area Seals: Non-slip seals designed for installation on treads and risers and to lie flat with adjacent surfaces, and complying with ADA guidelines for public areas.

   a. Secondary Seal: Manufacturer's standard extruded-elastomeric seal designed to prevent water and moisture infiltration.

D. Standard Joint Cover Requirements

1 Maximum Joint Width: **As indicated**.
2 Nominal Joint Width: **As indicated**.
3 Type of Movement Capability: **Seismic**.
4 Cyclic-Movement-Test-Response Characteristics: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399 including Appendix X3.
5 Exposed Cover Material: **Aluminum**, unless noted otherwise
6. Exposed Frame Material: Same material and finish as exposed cover material.
7. Moisture Barrier: Provide manufacturer's standard unit.
8. Fire-Resistance Ratings: Provide manufacturer's standard fire barrier with a rating not less than that of adjacent construction.

2.4 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.5 FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to architectural joint system manufacturer's written instructions.

B. Coordinate and furnish anchorages, Placement Drawings, and instructions for installing joint systems to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting-in of frames.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary to secure joint systems to in-place construction, including threaded fasteners with drilled-in

expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for handling and installing architectural joint assemblies and materials, unless more stringent requirements are indicated.

B. Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.

C. Terminate exposed ends of exterior architectural joint assemblies with factory-fabricated termination devices to maintain waterproof system.

D. Install factory-fabricated transitions between building expansion-joint cover assemblies and roof expansion-joint assemblies, to provide continuous, uninterrupted, watertight construction.

E. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required to install joint systems.

1. Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.
3. Set covers in horizontal surfaces at elevations that place exposed surfaces flush with adjoining finishes.
4. Locate covers in continuous contact with adjacent surfaces.
5. Securely attach in place with required accessories.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

F. Continuity: Maintain continuity of joint systems with a minimum number of end joints and align metal members. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials, if any, to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

G. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and end joints.

3.3 CLEANING AND PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

END OF SECTION 079500

SECTION 081113 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes steel doors and frames, interior and exterior as scheduled.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.
2. Division 4 Section “Unit Masonry Assemblies”
3. Division 6 Section “Panel Sheathing”
4. Division 7 Section “Fluid Applied Membrane Air Barriers”
5. Division 7 Section “Sheet Metal Flashing and Trim”
6. Division 7 Section “Joint sealants”
7. Division 8 Section "Door Hardware" for door hardware.
8. Division 8 Section "Glazing" for glass in steel doors and sidelights.
9 Division 9 Section Gysum Drywall Assemblies for building in door frames
10. Division 9 Section "Painting" for field painting primed doors and frames.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of door, frame and panel specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.

C. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

D. Shop Drawings showing fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
   1. Show waterproofing accessories, sealant profiles and door threshold transitions.

E. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings.

   1. Indicate coordination of glazing frames and stops with glass and glazing requirements.

1.4 QUALITY ASSURANCE

A. Provide doors and frames complying with ANSI/SDI 100 "Recommended Specifications for Standard Steel Doors and Frames" and as specified.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at **positive pressure**according to **NFPA 252**
   1. Temperature-Rise Limit: **At vertical exit enclosures and exit passageways**, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Inspect doors and frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect; otherwise, remove and replace damaged items as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4-inch- (100-mm-) high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If cardboard wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Steel Doors and Frames:

a. Amweld, Inc.
b. Ceco Door Products.
c. Curries Co.
d. Fenestra Corp.
e. Kewanee Corp.
f. Steelcraft.

2.2 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial-quality carbon steel, pickled and oiled, complying with ASTM A 569 (ASTM A 569M).

B. Cold-Rolled Steel Sheets: Carbon steel complying with ASTM A 366 (ASTM A 366M), commercial quality, or ASTM A 620 (ASTM A 620M), drawing quality, special killed. Provide galvanized sheet for exterior panels

C. Supports and Anchors: Fabricated from not less than 0.0478-inch- (1.2-mm-) thick steel sheet; 0.0516-inch- (1.3-mm-) thick galvanized steel where used with galvanized steel frames.

D. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize complying with ASTM A 153, Class C or D as applicable.

2.3 DOORS

A. Steel Doors: Provide 1-3/4-inch- (44-mm-) thick doors of materials and ANSI/SDI 100 grades and models specified below, or as indicated on Drawings or schedules:

1. Interior Doors: Grade II, heavy-duty, Model 1 or 2, minimum 16-gage thick steel sheet faces.

2. Exterior Doors: Provide doors complying with requirements indicated by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level: Level 3 and Physical Performance Level A (Extra Heavy Duty), Model **2 (Seamless)**..

B. Hardware Reinforcement: Fabricate reinforcement plates from same material as door face sheets to comply with the following minimum sizes:

1. Hinges: Minimum 0.123 inch (3.0 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (152 mm) longer than hinge, secured by not less than 6 spot welds.
2. Lock Face Closers, and Concealed Holders: Minimum 0.067 inch (1.7 mm) thick.
3. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.

C. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.

2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

2.4 FRAMES

A. Provide metal frames for doors, sidelights, borrowed lights, and other openings, according to ANSI/SDI 100, and of types and styles as shown on Drawings and schedules. Conceal fastenings, unless otherwise indicated. Fabricate frames of minimum 16-gage cold-rolled steel sheet. Galvanized at exterior locations

1. Fabricate frames with mitered or coped and continuously welded corners.
2. Fire rated for openings shown

B. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.

C. Plaster Guards: Provide minimum 0.0179-inch- (0.45-mm-) thick steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

D. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:

1. Hinges: Minimum 0.123 inch (3.0 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (152 mm) longer than hinge, secured by not less than 6 spot welds.
2. Lock Face Closers, and Concealed Holders: Minimum 0.067 inch (1.7 mm) thick.
3. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.

2.5 FABRICATION

A. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site. Comply with ANSI/SDI 100 requirements.

1. Internal Construction: Manufacturer's standard honeycomb, polystyrene, vertical steel stiffeners, or rigid mineral fiber core with internal sound deadener on inside of face sheets where appropriate in accordance with SDI standards.
No welded stiffeners permitted that show in face of door panel

2. Clearances: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between non-fire-rated pairs of doors. Not more than 3/4 inch (19 mm) at bottom.

B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel sheet.

C. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.

E. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

F. Thermal-Rated (Insulating) Panels: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal-insulating door and frame assemblies and tested according to ASTM C 236 or ASTM C 976 on fully operable door assemblies.

1. Unless otherwise indicated, provide thermal-rated assemblies with U-value rating of 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K) or better.

G. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of SDI 107 and ANSI A115 Series specifications for door and frame preparation for hardware.

1. For door openings as scheduled, prepare frames to receive full length hinges.

H. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

I. Locate hardware as indicated on Shop Drawings or, if not indicated, according to the Door and Hardware Institute's (DHI) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

J. Glazing Stops: Minimum 0.0359-inch- (0.9-mm-) thick steel or 0.040-inch- (1-mm-) thick aluminum.

1. Provide nonremovable stops on secure side of interior doors for glass, and other panels in doors.
2. Provide screw-applied, removable, glazing beads on inside of glass

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

B. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for steel sheet finishes.

C. Apply primers to doors and frames after fabrication.

2.7 GALVANIZED STEEL SHEET FINISHES – EXTERIOR DOORS AND FRAMES

A. Surface Preparation: Clean surfaces with nonpetroleum solvent so that surfaces are free of oil or other contaminants. After cleaning, apply a conversion coating of the type suited to the organic coating applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.

B. Factory Priming for Field-Painted Finish: Apply air-dried primer specified below immediately after cleaning and pretreatment.

1. Shop Primer: Zinc-dust, zinc-oxide primer paint complying with performance requirements of FS TT-P-641, Type II.

2.8 STEEL SHEET FINISHES

A. Surface Preparation: Solvent-clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel to comply with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP 8 (Pickling).

B. Factory Priming for Field-Painted Finish: Apply shop primer that complies with ANSI A224.1 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied topcoats. Apply primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable glazing stops located on secure side of opening.
d. Install door silencers in frames before grouting.
e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

1. In metal-stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In steel-stud partitions, attach wall anchors to studs with screws.
2. Install fire-rated frames according to NFPA 80.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

   a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
   d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to **NFPA 105**.

D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

3.2 ADJUSTING AND CLEANING

A. Prime Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements”
2. Division 6 Section “Interior Architectural Woodwork” for veneer faced casework matching doors
3. Division 8 Section “ Steel Doors and Frames” for frames
4. Division 8 Section "Glazing" for glass view panels in flush wood doors.

1.3 SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, trim for openings, and louvers.

1. Include factory-finishing specifications.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire ratings for fire doors.

D. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:

1. Faces of factory-finished doors with transparent finish. Show the full range of colors available for stained finishes.
2. Verify stain required to match existing to remain

E. Samples for Verification: As follows:

1. Corner sections of doors approximately 8 by 10 inches (200 by 250 mm) with door faces and edgings representing the typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.
2. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

C. Quality Standard: Comply with the following standard:
1. WDMA I.S.1-A, "Architectural Wood Flush Doors."

D. Forest Certification: Provide doors made with **not less than 70 percent of wood products** obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

E. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Test Pressure: Test at atmospheric pressure.
2. Oversized, Fire-Rated Wood Doors: For door assemblies exceeding sizes of tested assemblies, provide manufacturer's certificate stating that doors comply with all standard construction requirements of tested and labeled fire-door assemblies except for size.
3. Temperature-Rise Rating: At stairwell enclosures, provide doors that have a temperature-rise rating of 250 deg F (139 deg C) maximum in 30 minutes of fire exposure.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standard and manufacturer's written instructions.
1. Individually package doors in cardboard cartons and wrap bundles of doors in plastic sheeting.

B. Mark each door with individual opening numbers used on Shop Drawings. Use removable tags or concealed markings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. General Warranty: Door manufacturer's warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form, signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) more than 1/4 inch (6.35 mm) in a 42-by-84-inch (1067-by-2134-mm) section or that show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 75-mm) span, or do not comply with tolerances in referenced quality standard.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
2. Warranty shall be in effect during the following period of time after the date of Substantial Completion:

a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flush Wood Doors:

a. Algoma Hardwoods Inc.
b. Eggers Industries; Architectural Door Division.
c. Graham Manufacturing Corp.
d. Ideal Wood Products, Inc.
e. Marshfield Industries, Inc.
f. Oshkosh, Inc

2.2 DOOR CONSTRUCTION, GENERAL

A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

B. WDMA I.S.1-A Performance Grade:

1. Heavy Duty unless otherwise indicated.
2. Extra Heavy Duty: **public toilets, janitor's closets, exits**

C. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1**Grade LD-2, made with binder containing no urea-formaldehyde resin**.
2. Blocking: Provide wood blocking in particleboard-core doors **as needed to eliminate through-bolting hardware.**

   a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
   b. 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
   c. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

D. Doors for Transparent Finish: Comply with the following requirements:
1. Grade: Premium (Grade AA faces)
2. Faces: Maple plain sliced
3. Match between Veneer Leaves: Book match.
4. Match within Door Faces: Balance match.
5. Pair and Set Match: Provide for pairs of doors and for doors hung in adjacent sets.

2.3 SOLID-CORE DOORS

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A. Interior Veneer-Faced Doors: Comply with the following requirements:

1. Core: Particleboard core.
2. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

B. Fire-Rated Doors: Comply with the following requirements:

1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as required to provide fire rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated and as follows:

   a. 5-inch (125-mm) top-rail blocking.
   b. 5-inch (125-mm) bottom-rail blocking, at doors indicated to have kick, mop, or armor plates.
   c. 4-1/2-by-10-inch (114-by-250-mm) lock blocks.
   d. 5-inch (125-mm) midrail blocking, at doors indicated to have exit devices.
   e. As necessary to eliminate need for through-bolting hardware.

3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.
4. Pairs: Provide fire-rated pairs with fire-retardant stiles that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals.

2.4 LIGHT FRAMES

A. Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.0478-inch- (1.2-mm-) thick, cold-rolled steel sheet, factory primed and approved for use in doors of rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:

1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements of NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.

1. Light Openings: Trim openings with wood moldings of material and profile indicated in non-rated doors, metal moldings for fire rated doors.

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard's requirements for factory finishing.

B. Finish wood doors at factory.

C. Transparent Finish: Comply with requirements indicated for grade, finish system, staining effect, and sheen.

1. Grade: Premium.
2. Finish: Manufacturer's standard finish with performance requirements comparable to AWI System TR-6 catalyzed polyurethane.
3. Staining: Match Architect's sample to match existing to remain where indicated
4. Effect: Filled finish.
5. Sheen: Semigloss

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.

2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Division 8 Section "Door Hardware."

B. Manufacturer's Written Instructions: Install wood doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation, if fitting or machining is required at Project site.

3.3 ADJUSTING AND PROTECTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Refinish or replace doors damaged during installation.

C. Protect doors as recommended by door manufacturer to ensure that wood doors are without damage or deterioration at the time of Substantial Completion

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of access doors:

1. Wall and Ceiling access doors. An Allowance for 15 non-rated and 20 rated access doors are required for the Project.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.
2. Division 7 Section "Roof Accessories" for roof hatches.
3. Division 9 Section "Gypsum Board Assemblies" for gypsum board walls and ceilings.

1.3 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain access doors for entire Project from one source and by a single manufacturer.

B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are labeled and listed by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for vertical access doors.
2. ASTM E 119 for horizontal access doors and frames.

1.4 SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

D. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.

E. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

F. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acudor Products Inc.
2. Babcock-Davis Hatchways, Inc.
3. Bilco Co.
4. Dur-Red Products.
5. Karp Associates, Inc.
6. Milcor, Inc.

2.2 MATERIALS

A. Steel Sheet: ASTM A 366/A 366M commercial-quality, cold-rolled steel sheet with baked-on, rust-inhibitive primer.

B. Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Electrolytic zinc-coated steel sheet with Class C coating and phosphate treatment to prepare surface for painting.

C. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: for doors installed in ceramic tilewalls ASTM A 666, Type **304**. Remove tool and die marks and stretch lines or blend into finish.

1. Finish: **Manufacturer's standard**.

D. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

2.3 ACCESS DOORS

A. Flush Access Doors with Exposed Trim: Units consisting of frame with exposed trim, door, hardware, and complying with the following requirements:

1. Frame: 0.0598-inch- (1.52-mm-) thick steel sheet.
3. Door: 0.0747-inch- (1.90-mm-) thick stainless steel sheet at doors in toilet rooms Primed zinc coated steel sheet at other areas.
4. Trim: Flange integral with frame, 3/4 inch (19 mm) wide, overlapping surrounding finished surface.
5. Hinge: Continuous type.
6. Locks: Flush, key-operated cylinder lock.

2.4 FABRICATION

A. General: Manufacture each access door assembly as an integral unit ready for installation.

B. Steel Access Doors and Frames: Continuous welded construction. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. Exposed Flange: Nominal 1 to 1-1/2 inches (25.4 to 38.1 mm) wide around perimeter of frame.
2. For gypsum board assemblies, furnish frames with edge trim for gypsum board or gypsum base.

C. Locking Devices: Furnish one key-operated cylinder lock per door and flush, screwdriver-operated cam locks in number required to hold door in flush smooth plane when closed; if only one locking device is required to hold door as indicated above, provide only the key operated cylinder lock.

1. For cylinder lock, furnish 2 keys per lock and key all locks alike.

PART 3 - EXECUTION

3.1 PREPARATION

A. Advise Installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices. Furnish inserts and anchoring devices for access doors that must be built into other construction. Coordinate delivery with other work to avoid delay.

3.2 INSTALLATION

A. Comply with manufacturer's instructions for installing access doors.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finished surfaces.

C. Isolation: Where metal surfaces of units are to be installed in contact with incompatible metal or corrosive substrates, apply bituminous coating on concealed metal surfaces, or provide other permanent separation.

D. Install concealed-frame access doors flush with adjacent finish surfaces.

3.3 ADJUST AND CLEAN

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083326 - OVERHEAD COILING GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Open-curtain overhead coiling grilles, manually operated.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for miscellaneous steel supports.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design overhead coiling grilles, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Overhead coiling grilles shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Seismic Component Importance Factor: 1.0.

C. Operation Cycles: Provide overhead coiling grille components and operators capable of operating for not less than number of cycles indicated for each grille. One operation cycle is complete when a grille is opened from the closed position to the fully open position and returned to the closed position.

1.4 SUBMITTALS

A. Product Data: For each type and size of overhead coiling grille and accessory. Include the following:

1. Construction details, material descriptions, dimensions of individual components, profiles for curtain components, and finishes.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Open-Curtain Grille: 18-inch- (457-mm-) square assembly with full-size components consisting of rods, spacers, and links as required to illustrate each assembly.
2. Bottom Bar: 6 inches (150 mm) long.
3. Guides: 6 inches (150 mm) long.
4. Mounting Frame: 6 inches (150 mm) long.
5. Brackets: 6 inches (150 mm) square.
6. Hood: 6 inches (150 mm) square.

E. Delegated-Design Submittal: For overhead coiling grilles indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.
2. Summary of forces and loads on walls and jambs.

F. Qualification Data: For qualified Installer.

G. Seismic Qualification Certificates: For overhead coiling grilles, accessories, and components, from manufacturer.

H. Maintenance Data: For overhead coiling grilles to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain overhead coiling grilles from single source from single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

PART 2 - PRODUCTS

2.1 GRILLE CURTAIN MATERIALS AND CONSTRUCTION

A. Open-Curtain Grilles: Fabricate metal grille curtain as an open network of horizontal rods, spaced at regular intervals, that are interconnected with vertical links, which are formed and spaced as indicated and are free to rotate on the rods.

1. Aluminum Grille Curtain: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Endlocks: Continuous end links, chains, or other devices at ends of rods; locking and retaining grille curtain in guides against excessive pressures, maintaining grille curtain alignment, and preventing lateral movement.

C. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, finished to match grille.

1. Astragal: Equip each grille bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

D. Grille Curtain Jamb Guides: Manufacturer's standard shape having curtain groove with return lips or bars to retain curtain. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise; with removable stops on guides to prevent overtravel of curtain.

2.2 HOODS AND ACCESSORIES

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Aluminum: 0.040-inch- (1.02-mm-) thick aluminum sheet complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.

B. Mounting Frame: Manufacturer's standard mounting frame designed to support grille; factory fabricated from ASTM A 36/A 36M structural-steel [tubes] [or] [shapes], hot-dip galvanized per ASTM A 123/A 123M; fastened to floor and structure above grille; to be built into wall construction; and complete with anchors, connections, and fasteners.

C. Push/Pull Handles: Equip each push-up-operated or emergency-operated grille with lifting handles on each side of grille, finished to match grille.

2.3 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Provide cylinders standard with manufacturer and keyed to building keying system.
2. Keys: Three for each cylinder.

2.4 COUNTERBALANCING MECHANISM

A. General: Counterbalance grilles by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of parts and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.5 MANUAL GRILLE OPERATORS

A. Equip grille with manufacturer's recommended manual grille operator unless another type of grille operator is indicated.

B. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than **25 lbf (111 N)** force to turn crank. Fabricate gearbox to be oil tight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

2.6 OPEN-CURTAIN GRILLE ASSEMBLY

A. Open-Curtain Grille: Overhead coiling grille with a curtain having a network of horizontal rods that interconnect with vertical links.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ACME Rolling Doors.
   b. Alpine Overhead Doors, Inc.
   c. AlumaTek, Inc.
   d. City-Gates.
   e. Cookson Company.

f. Cornell Iron Works, Inc.
g. Dynaflair Corporation.
h. Dynamic Closures Corp.
i. Lawrence Roll-Up Doors, Inc.
j. Mahon Door Corporation.
k. McKeon Rolling Steel Door Company, Inc.
l. Metro Door.
m. Overhead Door Corporation.
n. Raynor.
o. Windsor Door.

B. Operation Cycles: Not less than 20,000.

C. Grille Curtain Material: Aluminum.

1. Space rods at approximately 2 inches (51 mm) o.c.
2. Space links approximately 6 inches (152 mm) apart in a straight in-line pattern.
3. Spacers: Metal tubes matching curtain material.

D. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

E. Hood: Aluminum.

1. Shape: Round.
2. Mounting: Face of wall.

F. Locking Devices: Equip grille with locking device assembly.

1. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from inside and outside with cylinders.

G. Manual Grille Operator: **Manufacturer's standard crank operator**
1. Provide operator with manufacturer's standard removable operating arm.

H. Grille Finish:

1. Aluminum Finish: Clear anodized.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coated Finish: **Color as selected by Architect from manufacturer's full range**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install overhead coiling grilles and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling grilles, hoods, and operators at the mounting locations indicated for each grille.

C. Accessibility: Install overhead coiling grilles, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that grilles operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling grilles.

END OF SECTION 083326

SECTION 084113 - ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of aluminum entrance and storefront work:

1. Exterior entrance doors.
2. Frames for entrances.
3. Storefront-type framing system for entrances, window assemblies and low-rise curtainwall applications fabricated from aluminum with recycled content
4. Supplemental bracing and supports required to attach to structure.
5. Sunshade Devices where shown.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 4 Section “Unit Masonry Assemblies”
2. Division 6 Section “Panel Sheathing”
3. Division 7 Section “Fluid Applied Membrane Air Barriers”
4. Division 7 Section “Sheet Metal Flashing and Trim”
5. Division 7 Section “Joint sealants”
6. Division 8 Section "Door Hardware" for door hardware.
7. Division 8 Section”Glass and Glazing” for glazing installed in aluminum entrances and storefronts, including entrances specified to be factory glazed.
8. Division 8 Section "Finish Hardware" for lock cylinders.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Provide aluminum entrance and storefront assemblies that comply with performance characteristics specified, as demonstrated by testing the manufacturer's corresponding stock assemblies according to test methods indicated.

B. Thermal Movement: Design the aluminum entrance and storefront framing systems to provide for expansion and contraction of the component materials. Entrance doors shall function normally over the specified temperature range.

1. The system shall be capable of withstanding a metal surface temperature range of 180 deg F (100 deg C) without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass, or other detrimental effects.

C. Design Requirements: Provide aluminum entrance and storefront systems that comply with structural performance, air infiltration, and water penetration requirements indicated.

1. Wind Loads: Provide aluminum entrance and storefront assemblies capable of withstanding wind pressures of 20 psf inward and 20 psf outward acting normal to the plane of the wall.

D. Structural Performance: Conduct tests for structural performance in accordance with ASTM E 330. At the conclusion of the tests there shall be no glass breakage or permanent damage to fasteners, anchors, hardware or actuating mechanism. Framing members shall have no permanent deformation in excess of 0.2 percent of their clear span.

1. Deflection Normal to the Plane of the Wall: Test pressure required to measure deflection of framing members normal to the plane of the wall shall be equivalent to the wind load specified above. Deflection shall not exceed 1/270 of the clear span, when subjected to uniform load deflection test.
2. Deflection Parallel to the Plane of the Wall: Test pressures required to measure deflection parallel to the plane of the wall shall be equal to 1.5 times the wind pressures specified above. Deflection of any member carrying its full dead load shall not exceed an amount that will reduce glass bite below 50 percent of the design dimension and shall not reduce the edge clearance between the member and the fixed panel, glass or other fixed member above to less than 1/4 inch. The clearance between the member and an operable door or window shall be at least 1/16 inch.

E. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span or 3/4 inch (19 mm), whichever is smaller.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

   a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, limited to 2 times the length of cantilevered member, divided by 175.

F. Air Infiltration: Provide aluminum entrance and storefront framing system with an air infiltration rate of not more than 0.06 CFM per sq. ft. of fixed area (excluding operable door edges) when tested in accordance with ASTM E 283 at an inward test pressure differential of 1.57 psf.

G. Water Penetration: Provide framing systems with no uncontrolled water penetration (excluding operable door edges) as defined in the test method when tested in accordance with ASTM E 331 at an inward test pressure differential of 6.24 lbf per sq. ft.

H. Water Penetration Field Test: Aluminum framed enrtrances shall be field tested in accordance with ASTM E1105-00 . Water penetration resistance tests shall be conducted at a static pressure of 6.25 psf continuously for 15 minutes. No leakage shall occur in accordance with section 3.2.2 and 10.2 of the referenced test method. The failure criteria specified by these sections states as follows: Penetration of water beyond a plane parallel to the glazing (the vertical plane) intersection the innermost projection of the test specimen, not including interior trim and hardware, under the specified conditions of air pressure difference across the specimen… Failure also occurs whenever water penetrates through the perimeter frame of the test specimen. Water contained within the drained flashing gutters and sills is not considered a failure.

I. Condensation Resistance: Where framing systems are "thermal-break" construction, provide units tested for thermal performance in accordance with AAMA 1503 showing condensation resistance factor (CRF) of not less than 45.

J. Energy Performance: Glazed storefront shall have certified and labeled energy performance ratings in accordance with NFRC.

1. Thermal Conductance: Provide aluminum-framed systems with U-factors in accordance with NFRC 100 by an accredited independent laboratory, and labeled and certified by the manufacturer/installer. Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.45 Btu/sq. ft. x h x deg F when tested according to NFRC 100.

2. Solar Heat Gain Coefficient: Provide aluminum-framed systems with solar heat gain coefficient in accordance with NFRC 200 by an accredited independent laboratory, and labeled and certified by the manufacturer/installer. Provide aluminum-framed systems with fixed glazing and framing areas having a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

1. Product data for each aluminum entrance and storefront system required, including:

a. Manufacturer's standard details and fabrication methods.
b. Data on finishing, hardware and accessories.
c. Recommendations for maintenance and cleaning of exterior surfaces.

2. LEED Submittal:

a. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

1. Include statement indicating costs for each product having recycled content.

b. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

3. Shop drawings for each aluminum entrance and storefront system required, including:

a. Layout and installation details, including relationship to adjacent work sealant profiles , integrated head jamb and sill flashing details INCLUDING COORDINATION REQUIRED FOR AIR BARRIER INTERFACE

b. Elevations at 1/4-inch scale.
c. Detail sections of typical composite members.

d. Anchors and reinforcement, including seismic restratint.
e. Hardware mounting heights.
f. Provisions for expansion and contraction.
g. Glazing details.

4. Hardware Schedule: Submit complete hardware schedule organized into sets based on hardware specified. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Include item name, name of the manufacturer and complete designations of every item required for each door opening.

   a. Where intent is shown in schematic schedules as specified herein, provide Complete operating system for doors indicated.

5. Test Reports: Provide certified test reports from a qualified independent testing laboratory showing that aluminum entrance and storefront systems have been tested in accordance with specified test procedures and comply with performance characteristics indicated.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed installations of aluminum storefront and entrances similar in design and extent to those required for the project and whose work has resulted in construction with a record of successful in-service performance.

B. Single Source Responsibility: Obtain aluminum entrance and storefront systems from one source and from a single manufacturer.

C. Design Criteria: The drawings indicate the size, profile, and dimensional requirements of aluminum entrance and storefront work required. Aluminum storefront by specified manufacturers may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

   1. Seismic restraint connections must be indicated

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver aluminum entrance and storefront components in the manufacturer's original protective packaging.

B. Store aluminum components in a clean dry location away from uncured masonry or concrete. Cover components with waterproof paper, tarpaulin or polyethylene sheeting in a manner to permit circulation of air.

   1. Stack framing components in a manner that will prevent bending and avoid significant or permanent damage.

1.7 PROJECT CONDITIONS

A. Field Measurements: Check openings by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the work.

1. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

1.8 WARRANTY

A. Warranty: Submit a written warranty, executed by the manufacturer, agreeing to repair or replace units that fail in materials or workmanship within the specified warranty period. Failures include, but are not necessarily limited to:

1. Structural failures including excessive deflection, excessive leakage or air infiltration.
2. Faulty operation.
3. Deterioration of metals, metal finishes and other materials beyond normal weathering.

B. Warranty Period: 3 years after the date of Substantial Completion.

C. The warranty shall not deprive the Owner of other rights or remedies the Owner may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide storefront systems manufactured by one of the following:

1. Amarlite Architectural Products.
2. Arcadia, Inc
3. EFCO
4. Kawneer Company, Inc.
5. Tubelite Inc.
6. United States Aluminum Corp.
7. Vistawall Architectural Products.
8. YKK AP America, Inc

2.2 MATERIALS

A. Aluminum Members: Alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221 for aluminum extrusions, ASTM B 209 for aluminum sheet or plate, and ASTM B 211 for aluminum bars, rods and wire.

B. Carbon steel reinforcement of aluminum framing members shall comply with ASTM A 36 for structural shapes, plates and bars, ASTM A 611 for cold rolled sheet and strip, or ASTM A 570 for hot rolled sheet and strip.

C. Glass and Glazing Materials: Comply with requirements of "Glass and Glazing" section of these specifications.

D. Fasteners: Provide fasteners of aluminum, nonmagnetic stainless steel, zinc plated steel, or other material warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors and other components.

1 Reinforcement: Where fasteners screw-anchor into aluminum members less than 0.125 inches thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard noncorrosive pressed-in splined grommet nuts.

2. Exposed Fasteners: Do not use exposed fasteners except for application of hardware. For application of hardware, use Phillips flat-head machine screws that match the finish of member or hardware being fastened.

E. Concealed Flashing: 0.0179-inch (26 gage) minimum dead-soft stainless steel, or 0.026-inch-thick minimum extruded aluminum of alloy and type selected by manufacturer for compatibility with other components.

F. Miscellaneous Trim: Provide interior sills, exterior sills, closures, flashings, trim and other elements in conjunction with or adjacent to storefront system. Fabricate from 0.060-inch-thick minimum aluminum finished to match other components, except fabricate interior and exterior sills from 0.125-inch-thick minimum aluminum.

G Brackets and Reinforcements: Provide high-strength aluminum brackets and reinforcements; where use of aluminum is not feasible provide nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A 123.

H Concrete and Masonry Inserts: Provide cast iron, malleable iron, or hot-dip galvanized steel inserts complying with ASTM A 123.

I Compression Weatherstripping: Manufacturer's standard replaceable compressible weatherstripping gaskets of molded neoprene complying with ASTM D 2000 or molded PVC complying with ASTM D 2287.

J. Sliding Weatherstripping: Manufacturer's standard replaceable weatherstripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, complying with AAMA 701.2.

K Sealants and Joint Fillers: Provide silicone sealant and accessory materials complying with Division 7 Section Joint Sealers and division 1 Section Sustainable Design Requirements.

L. Glazing Gaskets: Elastomeric extrusions standard with, or recommended by the storefront manufacturer.

2.3 HARDWARE

A. Provide heavy-duty hardware units as indicated, scheduled, or required for operation of each door, including the following items of sizes, number, and type recommended by manufacturer for service required; finish to match door.

B. Basic hardware components for sets will be comprised of the following components. Reference Section 087100 for scheduled hardware sets required.

1. Hinges.
2. Surface-Mounted Overhead Closers: .
3. Cylinders are supplied under another Division 8 Section for keying into the building system.
4. Panic Exit Hardware:
5. Door Pull: Mfr's std design as selected by Architect.
6. Push Bars: full-door-width single-bar push bar.
7. Thresholds
8. Door Stops: Floor-mounted type with rubber bumper, for anchoring into concrete.
9. Auto openers

2.4 COMPONENTS

A. Storefront Framing System: Provide storefront and entrance framing systems fabricated from extruded aluminum members of size and profile indicated. Provide for flush glazing storefront .

B. Entrance Door Frames: Provide tubular and channel frame entrance door frame assemblies, as indicated, with welded or mechanical joints in accordance with manufacturer's standards. Reinforce as necessary to support required loads.

C. Stile-and-Rail Type Entrance Doors: Provide tubular frame members of thick-wall extrusions.

1. Glazing: Fabricate doors to facilitate replacement of glass or panels, without disassembly of stiles and rails. Provide snap-on extruded aluminum glazing stops, with exterior stops anchored for nonremoval.
2. Design: Provide 1-3/4-inch-thick doors fabricated from nominal .188 thick extrusions and medium stile and rail design indicated on Drawings.

2.5 FABRICATION

A. General: Fabricate aluminum entrance and storefront components to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes and profile requirements are indicated on the drawings.

1. Thermal-Break Construction: Fabricate storefront framing system with an integrally concealed, low-conductance thermal barrier, located between exterior materials and exposed interior members to eliminate direct metal-to-metal contact. Use manufacturer's standard construction that has been in use for similar projects for period of not less than 3 years.

B. Prefabrication: Complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible before shipment to the Project site. Disassemble components only as necessary for shipment and installation.

1. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. Complete these operations for hardware prior to application of finishes.

2. Do not drill and tap for surface-mounted hardware items until time of installation at project site.
3. Make provisions for electronic security system as indicated on electrical drawings.

C. Reinforcing: Install reinforcing as required for hardware and as necessary for performance requirements, sag resistance and rigidity including support of sunshade devices.

D. Dissimilar Metals: Separate dissimilar metals with bituminous paint, or a suitable sealant, or a nonabsorptive plastic or elastomeric tape, or a gasket between the surfaces. Do not use coatings containing lead.

E. Continuity: Maintain accurate relation of planes and angles with hairline fit of contacting members.

F. Fasteners: Conceal fasteners wherever possible.

G. Weatherstripping: For exterior doors, provide compression weatherstripping against fixed stops. At other edges, provide sliding weatherstripping retained in adjustable strip mortised into door edge.

1. Provide EPDM or vinyl-blade gasket weatherstripping in bottom door rail, adjustable for contact with threshold.

2.6 FINISHES

A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

1. Clear Anodic Finish: AAMA 611, **AA-M12C22A41, Class I, 0.018 mm**

2.7 SUNSHADE CONSTRUCTION

A. Components: All blades and outrigger components shall be 6063-T5 aluminum alloy.
1. Outriggers to be mounted to wall using Aluminum “T” brackets bolted to the wall condition. Aluminum “T” brackets to be supplied by Sunshade manufacturer.
2. Outriggers mounted to aluminum glazing members to be anchored into framing members

3. Outriggers shall be flat aluminum members tubular or plate members as standard with manufacturer with bullnose profile.
4. Blades shall be arched extruded style. Blades shall be factory assembled to 1/4” outrigger plates using stainless steel, type F, thread cutting screws through internal screw slots in blades. Welding is not acceptable, blades must be removable in case of damage. Fasteners to be hex head..
5 Fascia to be clipped to the outriggers.
6 Design Standard: Kawneer TriFab Sunshade wedge shaped outriggers, with angular fascia and circular louvers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and supports, with the Installer present, for compliance with requirements indicated, installation tolerances, and other conditions that affect installation of aluminum entrances and storefronts. Correct unsatisfactory conditions before proceeding with the installation.

1. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation.

B. Set units plumb, level, and true to line, without warp or rack of framing members, doors, or panels. Install components in proper alignment and relation to established lines and grades indicated. Provide proper support and anchor securely in place.

C. Construction Tolerances: Install aluminum entrance and storefront to comply with the following tolerances:

1. Variation from Plane: Do not exceed 1/8 inch in 12 feet of length or 1/4 inch in any total length.
2. Offset from Alignment: The maximum offset from true alignment between two identical members abutting end to end in line shall not exceed 1/16 inch.
3. Diagonal Measurements: The maximum difference in diagonal measurements shall not exceed 1/8 inch.
4. Offset at Corners: The maximum out-of-plane offset of framing at corners shall not exceed 1/32 inch.

D. Separate aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

1. Zinc or cadmium plate steel anchors and other unexposed fasteners after fabrication.
2. Paint dissimilar metals where drainage from them passes over aluminum.
3. Paint aluminum surfaces in contact with mortar, concrete or other masonry with alkali resistant coating.

E. Drill and tap frames and doors and apply surface-mounted hardware items. Comply with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.

F. Set sill members and other members in bed of non-curing butyl sealant as indicated, or with joint fillers or gaskets as indicated to provide weathertight construction. Sealant shall be placed to avoid interference with weeps and system drainage. Comply with requirements of Division 7 for sealants, fillers, and gaskets.

1. Provide silicone sealant and joint fillers at juncture of storefront framing with other materials. Comply with requirements of Division 7 for sealants, fillers, and gaskets. Seal to aluminum frame, not to snap-on extension cover.

2. Set members in sill pan formed with ½ inch end dams.

3. Seal joints between sill and back dam for airtight performance .

G. Refer to "Glass and Glazing" Section of Division 8 for installation of glass indicated to be glazed into doors and framing.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: **Owner will engage** a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Air Infiltration: Areas shall be tested for air leakage of **1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. (0.03 L/s per sq. m),** of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of **1.57 lbf/sq. ft. (75 Pa)**

2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum **uniform** static-air-pressure difference of **0.67 times the static-air-pressure difference specified for laboratory testing under "Performance Requirements" Article, but not less than 4.18 lbf/sq. ft. (200 Pa)** and shall not evidence water penetration.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust operating hardware to function properly, for smooth operation without binding, and for weathertight closure.

3.5 CLEANING

A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.

B. Clean glass surfaces after installation, complying with requirements contained in the "Glass and Glazing" Section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

3.5 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 084113

SECTION 084126 - ALL-GLASS INTERIOR GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Interior all-glass storefront for Convenience Store

B. Related Sections:

   1. Division 8 Section "Glazing" for general glass requirements.
   2. Division 8 Section “Door Hardware” for hardware on all-glass entry doors.

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: All-glass systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Structural Performance: All-glass systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

   1. Seismic Loads: As indicated on Drawings.
   2. Deflection Limits: Deflection normal to glazing plane is limited to 1/175 of clear span or 3/4 inch (19 mm), whichever is smaller.

C. Delegated Design: Design all-glass systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all-glass system.

B. Shop Drawings: Show fabrication and installation details, including the following:

1. Plans, elevations, and sections.
2. Details of fittings and glazing, including isometric drawings of rail fittings.
3. Door hardware locations, mounting heights, and installation requirements.

C. Samples for Initial Selection: For each type of exposed finish indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Finishes: 6-inch- (150-mm-) long sections of patch fittings, accessory fittings, and other items.
2. Glass: 6 inches (150 mm) square, showing exposed-edge finish.
3. Door Hardware: For exposed door hardware of each type, in specified finish, full size..

E. Delegated-Design Submittal: For all-glass systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of all-glass systems.

F. Qualification Data: For qualified Installer.

G. Seismic Qualification Certificates: For all-glass systems, accessories, and components, from manufacturer.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for all-glass systems.

I. Field quality-control reports.

J. Maintenance Data: For all-glass systems to include in maintenance manuals.

K. Warranty: Sample of special warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for all-glass systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Source Limitations: Obtain all-glass systems from single source from single manufacturer.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups for all-glass systems including accessory fittings.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with all-glass systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of all-glass systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
c. Failure of operating components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ACI Distribution; a division of Vitro America, Inc.
2. Arch Aluminum & Glass Co., Inc.
3. Blumcraft of Pittsburgh.
4. Oldcastle Glass, Inc.
5. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.

2.2 MATERIALS

A. Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials.

1. Class 1: Clear monolithic.

a. Thickness: 1/2 inch (13 mm).

b. Locations: As indicated.

2. Exposed Edges: Machine ground and flat polished.
3. Butt Edges: Flat ground.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), with strength and durability characteristics of not less than Alloy 6063-T5.

1. Stainless-Steel Cladding: ASTM A 666, Type 304.

2.3 METAL COMPONENTS

A. Fitting Configuration:
1. All-Glass Storefronts: Continuous rail fitting at top and bottom. See drawings.

B. Patch Fittings: Stainless-steel-clad aluminum.

C. Rail Fittings:

1. Material: Stainless-steel-clad aluminum.
2. End Caps: Manufacturer's standard precision-fit end caps for rail fittings.

D. Anchors and Fastenings: Concealed.

2.4 FABRICATION

A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

2.5 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Mirrorlike Reflective, Nondirectional Polish: No. 8.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install all-glass systems and associated components according to manufacturer's written instructions.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Install joint sealants as specified in Division 7 Section "Joint Sealants".

3.3 ADJUSTING AND CLEANING

A. Remove excess sealant and glazing compounds and dirt from surfaces.

END OF SECTION 084126

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Conventionally glazed aluminum curtain wall systems fabricated from aluminum containing recycled content and all supporting braces and framework required to support systems from building structure.
   2. Supplemental or secondary bracing and framing as required for a complete installation, including seismic restraint.
   3. Sun Control Devices where indicated.

B. Related Sections include the following:

   1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5.
   2. Division 4 Section “Unit Masonry Assemblies”
   3. Division 6 Section “Panel Sheathing”
   4. Division 7 Section “Fluid Applied Membrane Air Barriers”
   5. Division 7 Section “Sheet Metal Flashing and Trim”
   6. Division 7 Section “Joint sealants”
   7. Division 7 Section "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain-wall systems and for sealants to the extent not specified in this Section.
   8. Division 8 Section “Aluminum Entrances and Storefront” for storefront construction and entrance doors.
   9. Division 8 Section "Glazing" for insulating-glass requirements.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide glazed aluminum curtain-wall systems, including anchorage, capable of withstanding, without failure, the effects of the following:

   1. Structural loads.
   2. Movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   3. Dimensional tolerances of building frame and other adjacent construction.
   4. Failure includes the following:

      a. Deflection exceeding specified limits.
      b. Thermal stresses transferred to building structure.
      c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
      d. Noise or vibration created by wind and thermal and structural movements.

e. Loosening or weakening of fasteners, attachments, and other components.
f. Sealant failure.

B. Curtainwall shall be laboratory tested to verify published performance characteristics. Field Mock-ups are to be included in the integrated, exterior wall mock-up and shall also be tested prior to production. Mock-ups shall include all representative components of each exterior wall system installed as they would be in the field.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings
2. Seismic Loads: As indicated on Drawings

D. Structural-Test Performance: Provide glazed aluminum curtain-wall systems, including anchorage, capable of withstanding test pressure indicated without material and deflection failures and permanent deformation of structural members exceeding 0.2 percent of span when tested according to ASTM E 330.

1. Submit reports of tests performed on manufacturer's standard assemblies
2. Test Pressure: 150 percent of positive and negative wind-load design pressures.
3. Test Duration: As required by design wind velocity.

E. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by curtain-wall systems without failing adhesively or cohesively. Provide sealant that fails cohesively before sealant releases from substrate when tested for adhesive compatibility with each substrate and joint condition required.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

F. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span or 3/4 inch (19 mm), whichever is smaller.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

   a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, limited to 2 times the length of cantilevered member, divided by 175.

G. Thermal Movements: Provide glazed aluminum curtain-wall systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2. Test Performance: No buckling, stress on glass, glazing-edge seal failure, sealant failure, excess stress on curtain-wall framing, anchors and fasteners, or reduction of performance when tested according to AAMA 501.5.

   a. Test Ambient Temperature Range: 0 to 120 deg F (minus 18 to 67 deg C)

H. Air Infiltration: Provide glazed aluminum curtain-wall systems with maximum air leakage of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

I. Water Penetration Under Static Pressure: Provide aluminum glazed curtain-wall systems that do not evidence water penetration when tested according to AAMA 503 at a minimum differential static pressure of 10 PSF.

J. Water Penetration Under Dynamic Pressure: Provide glazed aluminum curtain-wall systems that do not evidence water leakage when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive design wind load, but not less than 10 lbf/sq. ft. (479 Pa).

   1. Maximum Water Leakage: According to AAMA 501.1 Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.

K. Condensation Resistance: Provide glazed aluminum curtain-wall systems with condensation-resistance factor (CRF) of not less than 55 when tested according to AAMA 1503.

L. Average Thermal Conductance: Provide glazed aluminum curtain-wall systems with average U-factor of not more than 0.50 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

M. LEED Performance: All materials including aluminum will contain recycled content.

0. Energy Performance: Glazed Curtainwall shall have certified and labeled energy performance ratings in accordance with NFRC.

   1. Thermal Conductance: Provide aluminum-framed systems with U-factors in accordance with NFRC 100 by an accredited independent laboratory, and labeled and certified by the manufacturer/installer. Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.45 Btu/sq. ft. x h x deg F when tested according to NFRC 100.

   2. Solar Heat Gain Coefficient: Provide aluminum-framed systems with solar heat gain coefficient in accordance with NFRC 200 by an accredited independent laboratory, and labeled and certified by the manufacturer/installer. Provide aluminum-framed systems with fixed glazing and framing areas having a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. LEED Submittal:

1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of glazed aluminum curtain-wall systems.

1. Include structural analysis data signed and sealed by the qualified professional engineer, licensed in Utah, responsible for their preparation.

2. Include seismic restraint analysis and design.
3. Include sealant profiles at perimeter, integrated flashing details for head, jamb and sill. INCLUDING COORDINATION REQUIRED FOR AIR BARRIER INTERFACE

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

G. Welding certificates.

H. Qualification Data: For Installer.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for glazed aluminum curtain-wall systems.

J. Preconstruction Test Reports: For glazed aluminum curtain-wall systems.

K. Field quality-control test reports.

L. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing Work of this Section.

1. Engineering Responsibility: Preparation of data for glazed aluminum curtain-wall systems including the following:

a. Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 699 for testing indicated.

C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2. Design Standards: Kawneer 1600 Curtainwall System depths as indicated.

The use of a Design Standard is to establish a level of quality and appearance required for the work and is not to be construed as a restraint of trade or a limit of competition.

D. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

E. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings. Mock-ups to be included in the exterior wall integrated mock-up, as well as a “first installed” mock-up.
2. Field testing shall be performed on mockups according to requirements in Part 3 "Field Quality Control" Article.
3. Mock-ups shall serve as standard of quality for the work.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to glazed aluminum curtain-wall systems including, but not limited to, the following:

1. Review structural load limitations.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review required testing, inspecting, and certifying procedures.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain-wall systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating glazed aluminum curtain-wall systems without field measurements**. Coordinate construction to ensure that actual dimensions correspond to established dimensions**.

1.7 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of glazed aluminum curtain-wall systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration caused by thermal movements.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   d. Water leakage.
   e. Failure of operating components to function normally.

2. Warranty Period: 5 years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: The design for glazed aluminum curtain-wall systems is based on system as specified herein and shown on drawings. Subject to compliance with requirements, provide a comparable product by one of the following:

1. Kawneer

2. Arch Aluminum & Glass Co., Inc.
3. EFCO Corporation.
4. Tubelite, Inc.
5. United States Aluminum.
6. Vistawall Architectural Products.
7. Wausau Window and Wall Systems.
8. YKK America AP

2.2 FRAMING SYSTEMS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 611.
3. Hot-Rolled Sheet and Strip: ASTM A 570/A 570M.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads.
4. Finish exposed portions to match framing system.
5. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.

E. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

F. Concealed Flashing: Dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.

G. Exposed Flashing: Base flashing and other locations as shown. Match exposed finish of framing.

H. Framing Gaskets: As recommended by manufacturer for joint type.

I. Framing Sealants: As specified in Division 7 Section "Joint Sealants."

2.3 GLAZING SYSTEMS

A. Glazing: As specified in Division 8 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer for joint type and as follows:

1. Structural Sealant: ASTM C 1184, neutral-curing silicone formulation compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant, and approved by structural-sealant manufacturer for use in curtain-wall systems indicated.

   a. Color: As selected by Architect. Color selected may be custom with some manufacturers. To match color of framing.
   b. Type: Manufacturer's standard single or two component.
   c. Minimum Tensile Strength: 50 psi (345 kPa)
   d. Modulus of Elasticity: As required by structural-sealant-glazed curtain-wall system design to meet performance requirements.

2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other system components with which it comes in contact; and recommended by structural- and weatherseal-sealant and curtain-wall manufacturers for this use.

   a. Joint Movement Capability: Accommodates a 50 percent increase or decrease in joint width at time of application when measured according to ASTM C 719.
   b. Color: Matching structural sealant.

2.4 ACCESSORY MATERIALS

A. Insulating Materials: Specified in Division 7 Section "Building Insulation."

B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

C. Miscellaneous Trim: Provide exterior fascia, window stools, sills, closures, interior base closures, flashings, trim and other elements in conjunction with or adjacent to curtainwall system. Fabricate from 0.060-inch-thick minimum aluminum finished to match other components, except fabricate interior sills from 0.125-inch-thick minimum aluminum with finish as selected by Architect. Watertight and airtight performance is required.

2.5 FABRICATION

A. Form aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:

1. Sharp profiles, straight and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to prevent glazing-to-glazing contact and to maintain required glazing edge clearances.
6. Structural-sealant joints that do not carry gravity loads of glazing at limited areas as indicated by Drawings.

7. Provisions for reglazing from exterior for one story applications. Inside glazed at Second story.

C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

D. Factory-Assembled Frame Units:
1. Rigidly secure nonmovement joints.
2. Seal joints watertight, unless otherwise indicated.
3. Pressure equalize system at its interior face.
4. Install glazing to comply with requirements in Division 8 Section "Glazing."

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.6 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

1. Clear Anodic Finish: AAMA 611, **AA-M12C22A41, Class I, 0.018 mm**

2.7 SUNSHADE CONSTRUCTION

A. Components: All blades and outrigger components shall be 6063-T5 aluminum alloy.
1. Outriggers to be mounted to wall using Aluminum “T” brackets bolted to the wall condition. Aluminum “T” brackets to be supplied by Sunshade manufacturer.
2. Outriggers mounted to aluminum glazing members to be anchored into framing members
3. Outriggers shall flat aluminum members tubular or plate members as standard with manufacturer with bullnose profile.
4. Blades shall be arched extruded style set at am angle. Blades shall be factory assembled to 1/4” outrigger plates using stainless steel, type F, thread cutting screws through internal screw slots in blades. Welding is not acceptable, blades must be removable in case of damage. Fasteners to be hex head..
5 Fascia to be clipped to the outriggers.
6 Design Standard: Kawneer 1600 SunShade Wedge shaped outriggers, with angular fascia and circular louvers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions.
   2. Install all necessary brackets, reinforcing and structural support as required to fully support curtainwall system.
   3. Do not install damaged components.
   4. Fit joints to produce hairline joints free of burrs and distortion.
   5. Rigidly secure nonmovement joints.
   6. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
   7. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
   8. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified Division 8 Section "Glazing."

F. Install sealants as specified in Division 7 Section "Joint Sealants."

G. Install insulation materials as specified in Division 7 Section "Building Insulation."

H. Erection Tolerances: Install glazed aluminum curtain-wall systems to comply with the following maximum tolerances:

   1. Plumb: 1/8 inch in 10 feet (3 mm in 3 m); 1/4 inch in 40 feet (6 mm in 12 m).
   2. Level: 1/8 inch in 20 feet (3 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).
   3. Alignment:
      a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (13 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
      b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (13 to 25 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
      c. Where surfaces are separated by reveal or protruding element of 1 inch (25 mm) wide or greater, limit offset from true alignment to 1/4 inch (6 mm).

   4. Location: Limit variation from plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/2 inch (12.7 mm) over total length.

5. Hair-line butt joints in framing members

3.3 FIELD QUALITY CONTROL

A. Testing Agency: **Owner will engage** a qualified independent testing and inspecting agency to perform field tests and inspections.Indicate testing phases on Drawings.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Air Infiltration: Areas shall be tested for air leakage of **1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. (0.03 L/s per sq. m),** of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of **1.57 lbf/sq. ft. (75 Pa)**

2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum **uniform** static-air-pressure difference of **not less than 10.0 lbf/sq. ft.** and shall not evidence water penetration.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.3 ADJUSTING AND CLEANING

A. Remove excess sealant and glazing compounds, and dirt from surfaces.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of aluminum-framed windows containing recycled content installed in Storefront assemblies

1. Projected Windows storefront system with sunshades where shown

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for MR Credits 4 and 5 and IEQ 4.1
2. Division 4 Section “Unit Masonry Assemblies”
3. Division 6 Section “Panel Sheathing”
4. Division 7 Section “Fluid Applied Membrane Air Barriers”
5. Division 7 Section “Sheet Metal Flashing and Trim”
6. Division 7 Section “Joint sealants”
7. Division 8 Section "Door Hardware" for door hardware.
8. Division 8 Section "Aluminum Storefront."
9. Division 8 Section "Glazing" for glazing requirements for aluminum windows, including those specified to be factory glazed.
10 Division 8 Section "Glazed Aluminum Curtain Walls."
11. Division 10 Section for free-standing sunshades in matching profile.

1.3 DEFINITIONS

A. C: Commercial.

B. Performance grade number, included as part of the AAMA/NWWDA product designation code, is actual design pressure in pounds force per square foot (pascals) used to determine structural test pressure and water test pressure.

C. Structural test pressure, for uniform load structural test, is equivalent to 150 percent of design pressure.

D. Minimum test size is smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified and that are of test size indicated below:
   1. Size indicated.

B. AAMA/WDMA Performance Requirements: Provide aluminum windows of the performance class and grade indicated that comply with AAMA/NWWDA 101/I.S.2.

   1. Performance Class: **C**
   2. Performance Grade: **C-60.**
   3. Exception to AAMA/WDMA 101/I.S.2: In addition to requirements for performance class and performance grade, design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length **or 3/4 inch (19 mm), whichever is less,** at design pressure based on the following:

      a. Testing performed according to AAMA/WDMA 101/I.S.2, Uniform Load Deflection Test **or structural computations**.
      b. Structural computations.

C. Structural Performance: Provide aluminum windows capable of withstanding the following, including wind loads based on passing AAMA/WDMA 101/I.S.2, Uniform Load Structural Test, at basic wind speed indicated:

   1. Deflection: Based on passing AAMA/NWDMA 101/I.S.2, Uniform Load Deflection Test.

D. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2, Air Infiltration Test.
   1. Maximum Rate: 0.1 cfm/sq. ft. (2 cu. m/h x sq. m) of area at an inward test pressure of 6.24 lbf/sq. ft. (300 Pa).

E. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/I.S.2, Water Resistance Test.
   1. Test Pressure: 20 percent of positive design pressure, but not more than 12 lbf/sq. ft. (580 Pa).

F. Condensation-Resistance Factor: Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of **50**, where windows are indicated to be "thermally improved."

G. Thermal Movements: Provide aluminum windows, including anchorage, that accommodate thermal movements of units resulting from the following maximum change (range) in ambient and surface temperatures without buckling, distortion, opening of joints, failure of joint sealants, damaging loads and stresses on glazing and connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to solar heat gain and nighttime-sky heat loss.

   1. Temperature Change (Range): **120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces**.

H. Life-Cycle Testing: Test according to AAMA 910 and comply with AAMA/WDMA 101/I.S.2.

I. Windows: Comply with AAMA/WDMA 101/I.S.2 for the following tests:

1. Hardware Load Test.
2. Sash Torsion Test.
3. Torsion Test.
4. Horizontal Concentrated Load Test on Latch Rail.
5. Vertical Concentrated Load Test on Latch Rail.
6. Torsion Load Test on Intermediate Frame Rails.
7. Vertical Concentrated Load Test on Intermediate Frame Rails.
8. Balance Arm Load Test.

J. LEED Performance: All materials including aluminum will contain recycled content.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

B. LEED Submittal:

1. Product Data for Credit lEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

2. Product Data for Credit MR 4 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other Work, operational clearances, and the following:

1. Mullion details, including reinforcement and stiffeners.
2. Joinery details.
3. Expansion provisions.
4. Flashing and drainage details INCLUDING COORDINATION REQUIRED FOR AIR BARRIER INTERFACE
5. Weather-stripping details.
6. Thermal-break details.
7. Glazing details.
8. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation and used to determine the following:

   a. Structural test pressures and design pressures from basic wind speeds indicated.
   b. Deflection limitations of glass framing systems.
9. Locations of setting blocks and perimeter sealant profiles.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For aluminum window components required, prepared on Samples of size indicated below.

1. Main Framing Member: 12-inch- (300-mm-) long, full-size sections of extrusions with factory-applied color finish.
2. Hardware: Full-size units with factory-applied finish.
3. Weather Stripping: 12-inch- (300-mm-) long sections.
4. Architect reserves the right to require additional samples that show fabrication techniques, workmanship, and design of hardware and accessories.

F. Qualification Data: For **Installer and testing agency**.

G. Field Quality-Control Test Reports: From a qualified testing and inspecting agency engaged by Contractor.

H. Product Test Reports: Based on evaluation of comprehensive tests performed **within the last four years** by a qualified testing agency, for each type, grade, and size of aluminum window. Test results based on use of down-sized test units will not be accepted.

I. Maintenance Data: For **operable window sash, operating hardware, weather stripping and** finishes to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

B. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum windows and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Fenestration Standard: Comply with AAMA/WDMA 101/I.S.2, "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors," for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Provide **AAMA-**certified aluminum windows with an attached label.

E. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.

F. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Build mockup in building envelope wall.
2. Perform tests specified in "Field Quality Control" Article. Modify mockup construction and perform additional tests as required to achieve specified minimum acceptable results.

3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to aluminum windows including, but not limited to, the following:

1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review required testing and inspecting procedures.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Failure to meet performance requirements.
2. Structural failures including excessive deflection.
3. Water leakage, air infiltration, or condensation.
4. Faulty operation of movable sash and hardware.
5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
6. Insulting glass failure.

B. Warranty Period: **Five** years from date of Substantial Completion.

C. Warranty Period for Metal Finishes: **20** years from date of Substantial Completion.

D. Warranty Period for Glass: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Projected Windows:

a. Acorn Window Systems.
b. Custom Window Company.
c. EFCO Corporation.
d. Kawneer Company, Inc.
e. TRACO.
f. Winco Manufacturing Co.
g. YKK AP

B. Design Standard: Kawneer GlassVent Zero Sightline project Out window

1. The use of a Design Standard establishes as level of quality for the work and is not to be construed as a limit of competition or a restraint of trade

2.2 MATERIALS, GENERAL

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength, not less than 16,000-psi (110-MPa) minimum yield strength, and not less than 0.062-inch (1.6-mm) thickness at any location for the main frame and sash members.

B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components. **Cadmium-plated steel fasteners are not permitted.**

1. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125 inch (3.2 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated. **Cadmium-plated steel anchors, clips, and accessories are not permitted.**

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated. **Cadmium-plated steel reinforcing members are not permitted.**

1. Reinforce framing to adequately support sunshades

E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action, and completely concealed when aluminum window is closed.
   1. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/NWWDA 101/I.S.2.

F. Replaceable Weather Seals: Comply with AAMA 701/702.

G. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 GLAZING

A. Glass and Glazing Materials: Refer to Division 8 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

2.4 HARDWARE

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows and sized to accommodate sash or ventilator weight and dimensions. **Cadmium-plated hardware is not permitted.** Do not use aluminum in frictional contact with other metals. Where exposed, provide **nonmagnetic stainless steel**, or **cast white bronze for locking hardware.**

B. Four- or Six-Bar Friction Hinges: Comply with AAMA 904.

   1. Locking mechanism and handles for manual operation.
   2. Friction Shoes: Provide friction shoes of nylon or other nonabrasive, nonstaining, noncorrosive, durable material.

C. Gear-Type Rotary Operators: Comply with AAMA 901 when tested according to ASTM E 405, Method A.

   1. Operation Function: All ventilators move simultaneously and securely close at both jambs without using additional manually controlled locking devices.

   2. Travel limit setting for maximum projection of 12 inches.

2.5 FABRICATION

A. General: Fabricate aluminum windows, in sizes indicated, that comply with requirements and that meet or exceed AAMA/WDMA 101/I.S.2 performance requirements for the following window type and performance class. Include a complete system for assembling components and anchoring windows.
   1. Projected Windows: **C**.-60

B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.

C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

1. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.
2. Provide thermal barriers tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.
3. Provide hardware with low conductivity or nonmetallic material for hardware bridging thermal breaks at frame or vent sash.

D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.

E. Weep Holes: Provide factory drilled weep holes and internal passages to conduct infiltrating water to exterior.

F. Provide water-shed members above similar lines of natural water penetration.

G. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- (1.6-mm-) thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.

H. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 8 Section "Glazing" and with AAMA/WDMA 101/I.S.2.

I. Glazing Stops: Provide snap-on glazing stops coordinated with Division 8 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.6 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

1. Clear Anodic Finish: AAMA 611, **AA-M12C22A41, Class I, 0.018 mm**

2.7 INSECT SCREENS

A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on **inside** of window and provide for each operable exterior sash or ventilator.

1. Aluminum Tubular Frame Screens: Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," **Architectural C-24** class.

2. Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," for minimum standards of appearance, fabrication, attachment of screen fabric, hardware, and accessories unless more stringent requirements are indicated.

B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners and removable PVC spline/anchor concealing edge of frame.

1. Aluminum Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet with minimum wall thickness as required for class indicated.
2. Extruded-Aluminum or Aluminum Tubular Framing Sections and Cross Braces: Not less than **0.040-inch (1.0-mm)** wall thickness.
3. Finish: Match aluminum window members.

C. Aluminum Wire Fabric: 18-by-16 (1.1-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter, coated aluminum wire.

1. Wire-Fabric Finish: **Charcoal gray**.

D. Wickets: Provide **sliding or hinged** wickets, framed and trimmed for a tight fit and for durability during handling.

2.8 SUNSHADES

A. Components: All blades and outrigger components shall be 6063-T5 aluminum alloy.
1. Outriggers to be mounted to wall using Aluminum “T” brackets bolted to the wall condition. Aluminum “T” brackets to be supplied by Sunshade manufacturer.
2. Outriggers mounted to aluminum glazing members to be anchored into framing members
3. Outriggers shall flat aluminum members tubular or plate members as standard with manufacturer with bullnose profile.
4. Blades shall be arched extruded style set at am angle. Blades shall be factory assembled to 1/4” outrigger plates using stainless steel, type F, thread cutting screws through internal screw slots in blades. Welding is not acceptable, blades must be removable in case of damage. Fasteners to be hex head..
5 Fascia to be clipped to the outriggers.
6 Design Standard: Kawneer TriFab Sunshade Wedge Shaped outrigger with angular fascia and Circular Louver.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances; rough opening dimensions; levelness of sill plate; coordination with wall flashings, vapor retarders, and other built-in components; operational clearances and other conditions affecting performance of work.
1. Framed Walls: Dry, clean, sound, well anchored, free of voids, and without offsets at joints. Ensure that screw heads are flush with surfaces in opening and within 3 inches (76 mm) of opening.
2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components; Drawings; and Shop Drawings.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set framing members in preformed sill pans set in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/NWWDA 101/I.S.2.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections and prepare test reports.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to ASTM E-783-02 Air leakage resistance tests shall be conducted at a uniform static pressure of 6.24 psf. The maximum allowable rate of air leakage shall not exceed 0.30 cfm/ft for operable units

2. Test for field leaks with static and/or cyclical pressures in accordance with ASTM E1105.

C. Remove and replace noncomplying aluminum window and retest as specified above.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 ADJUSTING

A. Adjust operating sashes and ventilators, screens, hardware, **operators,** and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

3.5 PROTECTION AND CLEANING

A. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain window operating system. Refer to Division 1 Section "**Closeout Procedures**."

END OF SECTION 085113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Commercial door hardware for the following:

   a. Swinging doors.
   b. Fire-rated swinging doors.

2. Cylinders for doors specified in other Sections.
3. Electrified door hardware.

B. Related Sections include the following:

1. Division 08 Section "Hollow Metal Doors and Frames"
2. Division 08 Section "Aluminum-Framed Entrances and Storefronts"
3. Division 08 Section "Flush Wood Doors"
4. Division 26 Sections for connections to electrical power system and for low-voltage wiring work.
5. Division 28 Section "Access Control" for access control devices installed at door openings and provided as part of a security access system.
6. Division 28 Section "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion detection system.
7. Division 28 Section "Fire Detection and Alarm" for connections to building fire alarm system.

C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

1. Thresholds, weather stripping, and cylinders for locks specified in other Sections.

1.3 SUBMITTALS

A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: Power, signal, and control wiring. Include the following:

   a. System schematic.

b. Point-to-point wiring diagram.
c. Riser diagram.
d. Elevation of each door.

2. Detail interface between electrified door hardware and fire alarm, access control, security, building control system.
3. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

C. Samples for Verification: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets, if requested.

1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks, latches, and closers as requested.

F. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

G. Warranty: Special warranty specified in this Section.

H. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
2. Content: Include the following information:

a. Identification number, location, hand, fire rating, and material of each door and frame.
b. Type, style, function, size, quantity, and finish of each door hardware item.
c. Complete designations of every item required for each door or opening including name and manufacturer.
d. Fastenings and other pertinent information.
e. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
f. Explanation of abbreviations, symbols, and codes contained in schedule.
g. Mounting locations for door hardware.
h. Door and frame sizes and materials.
i. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

1) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

j. List of related door devices specified in other Sections for each door and frame.

3. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.

I. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
2. Installer shall have warehousing facilities in Project's vicinity.
3. Scheduling Responsibility: Preparation of door hardware and keying schedules.
4. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 and UBC Standard 7-2.

1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1016 mm) or less above the sill.

E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

1.6 COORDINATION

A. Coordinate layout and installation of recessed hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Coordinate with aluminum entrance door supplier for door hardware installation.

D. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and building control system.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including excessive deflection, cracking, or breakage.
   b. Faulty operation of operators and door hardware.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three (3) years from date of Substantial Completion, except as follows:

   a. Exit Devices: Two (2) years from date of Substantial Completion.
   b. Manual Closers: Ten (10) years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide six (6) months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive

maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

1.9 EXTRA MATERIALS

A. Furnish full-size units of door hardware described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Door Hardware:

a. 2 each exit devices VD XP98TP X 626
b. 2 each locksets C-R CL3357 NZD X 626
c. 2 each surface closers LCN 4041 HEDA 689.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Products:

a. Finish: Shall be US26D, unless otherwise noted.
b. Manufacture Standard:

1) Butts: Hager, McKinney, Stanley, Ives*
2) Locksets: Schlage, Sargent, Corbin Russwin*
3) Closers: Sargent, LCN*
4) Exit Devices: Sargent, Von Duprin*
5) Auto Operators: Horton, LCN*
6) Trim: BBW, Rockwood, Hager, Ives*
7) Weatherstrip: Pemko, Hager, National Guard*
8) Continuous Hinges: HagerRoton, Markar, Ives*
9) Magnetic Door Holders: Rixson, LCN*
10) Rem Mullion: Sargent, Von Duprin*

B. Substitution requests will be made in accordance with Division 01 requirements.

2.2 SCHEDULED HARDWARE

A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:

1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware

type, the comparable product of one of the other manufacturers that complies with requirements.

2. ANSI/BHMA designations used elsewhere in this Section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this Section.

   a. Butts and Hinges: ANSI A156.1.
   b. Bored and Preassembled Locks and Latches: ANSI/BHMA A156.2.
   c. Exit Devices: ANSI A156.3.
   d. Door Controls - Closers: ANSI A156.4. 180 degree swing only!
   e. Auxiliary Locks and Associated Products: ANSI/BHMA A156.5.
   f. Architectural Door Trim: ANSI A156.6.
   g. Template Hinge Dimensions: ANSI A156.7.
   h. Door Controls - Overhead Holders: ANSI A156.8.
   i. Mortise Locks and Latches: ANSI A156.13.
   j. Closer Holder Release Devices: ANSI A156.15.
   k. Auxiliary Hardware: ANSI A156.16.
   l. Self-Closing Hinges and Pivots: ANSI A156.17.
   m. Materials and Finishes: ANSI A156.18.

2.3 MATERIALS AND FABRICATION

A. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

B. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

C. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

D. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.4 HINGES, GENERAL

A. Quantity: Provide the following, unless otherwise indicated:

   1. Two Hinges: For doors with heights up to 60 inches.
   2. Three Hinges: For doors with heights 61 to 90 inches.

B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

C. Hinge Weight: As indicated in hardware sets.

D. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless steel with stainless-steel pin.
2. Interior Hinges: Steel with steel pin.
3. Hinges for Fire-Rated Assemblies: Steel with steel pin.

E. Hinge Options: Where indicated in door hardware sets or on Drawings:

1. Safety Stud: Designed for stud in one leaf to engage hole in opposing leaf.
2. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging doors.
3. Corners: Square.

F. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors and frames.
3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.

2.5 CONTINUOUS HINGES

A. Hinges shall be a geared continuous hinge utilizing a single gear section for the door leaf and a separate gear section for the frame side of the door. The door leaf and jamb leaf shall fully mortised where scheduled, and full surface where scheduled.. Geared hinges are to be certified to ANSI 156.25, Grade 2 and UL 10C tested and approved for 90 minutes.

B. Hinge Manufacturers: Subject to compliance with requirements, provide hinges of the following approved manufacturers:

1. Ives
2. McKinney
3. Hager

2.6 LOCKS, LATCHES, AND BOLTS

A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.

B. Lock Throw: Provide 5/8-inch (16-mm) minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

C. Flush Bolt Heads: Minimum of 1/2-inch- (13-mm-) diameter rods of brass, bronze, or stainless steel with minimum 12-inch- (300-mm-) long rod for doors up to 84 inches (2100 mm) in height. Provide longer rods as necessary for doors exceeding 84 inches (2100 mm) in height.

D. Cylindrical Locks - ANSI A156.2 Series 4000, Grade 1 Strength and Operational requirements. Meets A117.1 Accessibility Codes. Latch bolts shall be steel with minimum ½” throw, deadlocking on keyed and exterior functions. ¾” throw anti-friction latchbolt on pairs of fire

doors. Locksets to be tested to exceed 3,000,000 cycles. Lock case shall be steel. Provide 5/8" minimum throw of latch and deadbolt used on pairs of doors.

E. Lockset Manufacturers: Subject to compliance with requirements, provide locksets of the following approved manufacturers:

1. Corbin Russwin CL3300 Series
2. Schlage ND Series
3. Sargent 10 Line

2.7 KEYING REQUIREMENTS

A. Furnish temporary keyed cores for the construction period, and remove these when directed. The construction cores remain property of the supplier and shall be returned to the supplier when they are removed. Contractor shall install the permanent cores in the presence of the owner's representative.

B. Cylinders/Cores: Furnished by Owner.

2.8 PUSH/PULL UNITS

A. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation, thru-bolted.

2.9 CLOSERS

A. Accessibility Requirements: Where handles, pulls, latches, locks and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural Transportations Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Comply with the following maximum opening-force requirements:

a. Interior, Non-fire-rated Hinged Doors: 5 lbf applied perpendicular to door.
b. Fire Doors: Minimum opening force allowable by Authorities Having Jurisdiction (AHJ).

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15lbf to open door to minimum required width.

C. Cylinder: Shall be of high strength cast iron construction. All door exterior closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified independent testing laboratory. Cylinder shall have been manufactured and in the marketplace for a minimum of 10 years

D. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory sized closers, adjustable to meet field conditions and requirements for opening force.

E. Surface Closers: BHMA A156.4 Grade 1. Provide type of arm required for closer to be parallel mounted and thru-bolted using heavy duty arms.

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Thru-bolts at wood doors unless doors are provided with closer blocking. Non-sized, non-handed, and adjustable.
4. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
5. Opening pressure: Exterior doors 8.5 lb., interior doors 5 lb., labeled fire doors 15 lb.
6. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
7. Non-flaming fluid will not fuel door or floor covering fires.

F. Surface Closer Manufacturers: Subject to compliance with requirements, provide closers of the following approved manufacturers:

1. LCN 4040 Series
2. Sargent 281 Series

2.10 DOOR OPERATORS / ADA SPECIAL CLOSERS

A. Where low kinetic energy, as defined by ANSI Standard A156.19, Surface Door Operators shall be electrically powered closers complying with the 1990 ADA requirements for opening force and time to close standards. Full closing force controlled by the hydraulic sweep and latch valves shall be provided when the power or assist cycle ends.

B. Door Operators shall be rack and pinion action with one-piece forged steel pistons.

C. Separate adjusting valves shall be provided for closing speed, latching speed and back-check.

D. Adjusting valves shall be made of a metal material, regulating the fluid through a “V-SLOT” valve, concealed, adjustable only with special wrench, and shall be seated with “O” type rings.

E. Door Operators and supporting equipment shall carry a manufacturers two (2) year warranty.

F. Door Operator shall have built in the following features:

1. Opening Speed adjustment.
2. Opening Force adjustment (15 lb. Maximum).
3. Time Delay.
4. On-board Diagnostics.
5. On-board power supply.
6. Factory default memory.
7. On/off switch.
8. Hold open switch.
9. On-board capabilities to be either wired for simultaneous or sequential operation at vestibules.
10. Out-put triggers for electric strikes or electric latch retraction.

G. Auto Operator Manufacturers: Subject to compliance with requirements, provide auto operators of the following approved manufacturers:

1. LCN Closers - 4640 Series

2. Horton 4000LE

2.11 EXIT DEVICES/PANIC HARDWARE

A. General features: BHMA A156.3, Grade 1.

B. Accessibility Requirements: Where handles, pulls, latches, locks and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural Transportations Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.

C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15lbf to release the latch. Locks shall not require use of a key, tool of special knowledge for operation.

D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to AHJ for panic protection, based on testing according to UL 305.

1. Push-through touch pad design. No exposed touch bar fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
2. No exposed screws to show through glass doors.
3. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.
4. Static force resistance in excess of 2000 lbs on devices where scheduled.
5. 90 degree latchbolt engagement on devices where scheduled.
6. Lever Trim: Vandal resistant, forged brass or bronze escutcheon min .130" thickness, match lockset lever design.
7. Fire-Labeled Devices: UL label indicating "Fire Exit Hardware". Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.
8. Electrically Operated Devices: Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.
9. Furnish all exit devices with deadlocking latchbolts.
10. End caps shall be sloped and of heavy-duty metal alloy construction and provide horizontal adjustment to provide flush alignment with device cover plate. When device end cap is installed, no raised edges will protrude. End cap shall be cast metal or forged aluminum and have a minimum thickness of (.250"). Plastic or metal stamping will not be acceptable.
11. Provide all shim kits and filler plates to allow flush mounting of exit devices on all types of doors used in this project.
12. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key.

E. Exit Device Manufacturers: Subject to compliance with requirements, provide exit devices of the following approved manufacturers:

1. Von Duprin 98 series
2. Sargent 19-43-GL-8800 Series

2.12 TRIM AND STOPS

A. Kick plates, mop plates, and armor plates, shall be .050 gauge with 32D finish. Kick plates to be 10” high, mop plates to be 5” high. All plates shall be two (2) inches less full width of door.

B. Push plates, pull plates, door pulls, and miscellaneous door trim shall be shown in the hardware schedule.

C. Doorstops shall be furnished for all doors to prevent damage to doors or hardware from striking adjacent walls or fixtures. Wall stops are preferred. Floor stops are used only where noted in hardware schedule. Where conditions prohibit the use wall type stops, furnish overhead stops either surface mounted or concealed as noted in hardware sets.

D. Trim and Stop Manufacturers: Subject to compliance with requirements, provide trim and stops of the following approved manufacturers:

1. Ives
2. Rockwood
3. Hager

2.13 WEATHERSTRIPPING AND SEALS

A. General: Provide continuous weatherstripping on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

B. Weatherstripping Manufacturers: Subject to compliance with requirements, weatherstripping of the following approved manufacturers:

1. NGP
2. Pemko
3. Hager

2.14 THRESHOLDS

A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size, and profile as shown or scheduled.

B. Threshold Manufacturers: Subject to compliance with requirements, thresholds of the following approved manufacturers:

1. NGP
2. Pemko
3. Hager

2.15 ELECTRICAL HARDWARE

A. Furnish wiring diagrams to electrical contractor for use in installing electrical hardware products.

B. Electrical contractor to run all wiring and make all final connections for electrified hardware. Hardware supplier shall be responsible to furnish all wiring diagrams to operate electrified hardware. Access control material and electrified hardware to interface at junction boxes.

2.16 HARDWARE FINISHES

A. Match items to the manufacturer's standard color and texture finish for the latch and locksets (or push-pull units if no latch or lock sets).

B. Provide finishes that match those established by BHMA or, if none established, match the Architect's sample.

C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

D. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: Comply with DHI A115 Series.

1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

B. Wood Doors: Comply with DHI A115-W Series.

3.3 INSTALLATION

A. Pre-installation conference shall be conducted prior to installation of hardware at Project site. Meet with the, Owner, Contractor, installer, and manufacturers representatives. A separate pre-installation conference shall be conducted prior to the installation of electronic security hardware with the electrical contractor Review catalogs, brochures, templates, installation instructions, and the approved hardware schedule. Survey installation procedures and workmanship, with special emphasis on unusual conditions, as to ensure correct technique of installation, and coordination with other work. Notify participants at least ten, 10 working days before conference.

B. Hardware Installers must have a minimum of five (5) years experience in installation of hardware. Provide verification of installer's qualification to Consultant for approval. All installers to attend review meetings with the hardware distributor.

C. Install hardware using only manufacturer supplied and approved fasteners in strict adherence with manufacturers published installation instructions.

D. Install head seal prior to installation of "PA"-parallel arm mounted door closers and push side mounted door stops/holders. Trim, cut and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Install thresholds and saddles in a bed of caulking completely sealing the underside from water and air penetration.

E. Counter sink through bolt of door pull under push plate during installation.

F. Mounting Heights: Mount door hardware units at heights indicated, as follows, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

G. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

H. Boxed Power Supplies: Locate power supplies as indicated. Verify location with Architect.

1. Configuration: Provide one power supply for each door opening.
2. Configuration: Provide the least number of power supplies required to adequately serve doors with electrified door hardware.

I. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

2. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

DOOR HARDWARE SETS

HW SET: 01

DOOR NUMBER:

105	109	113	124	125	132
134	138	141	205	209	213
216	217	218	221	225	231
236	239	305	309	313	317
321	325	333	338	341	

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 SCUSH TB	689	LCN
1	SET	SEALS	2525B	BRN	NGP

HW SET: 02

DOOR NUMBER:

126

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 03

DOOR NUMBER:

115	117	119	121

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	5050B	BRN	NGP
1	EA	DOOR SWEEP	601A	AL	NGP

HW SET: 04

DOOR NUMBER:
127

EACH TO HAVE:

3	EA	HINGE	5BB1HW 5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 SCUSH TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 05
DOOR NUMBER:
123

EACH TO HAVE:

1	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELEC HINGE	TEF10C 4.5 X 4.5	652	MAR
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	ELECTRONIC LOCK	AD-300-CY-70-MG-RHO-LD (BY SECURITY INT)	626	SCE
1	EA	SURFACE CLOSER	4041 SCUSH TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	INTERFACE BOARD	PIB300-2D (BY SECURITY INT)		SCE
1			POWER SUPPLY BY SECURITY INTEGRATOR		B/O

HW SET: 06
DOOR NUMBER:
228 328

EACH TO HAVE:

5	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELEC HINGE	TEF10C 4.5 X 4.5	652	MAR
1	SET	AUTO FLUSH BOLT	FB41P	630	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	ELECTRONIC LOCK	AD-300-CY-70-MG-RHO-LD (BY SECURITY INT)	626	SCE
1	EA	COORDINATOR	COR X FL X BRACKETS AS REQ'D	628	IVE
1	SET	ASTRAGAL	9605A 84"	AL	NGP
2	EA	SURFACE CLOSER	4041 SCUSH TB	689	LCN
1	SET	SEALS	2525B	BRN	NGP
1	EA	INTERFACE BOARD	PIB300-2D (BY SECURITY INT)		SCE
1			POWER SUPPLY BY SECURITY		B/O

INTEGRATOR

HW SET: 07
DOOR NUMBER:
199B 199C

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	98L-BE-F 996L-BE 499F	626	VON
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 08
DOOR NUMBER:
299B 299C 399B 399C

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT-10	689	VON
1	EA	FIRE EXIT HARDWARE	XP98L-F E996L 954 FS	626	VON
1	EA	RIM CYLINDER	RIM CYLINDER BY OWNER (NIC)	626	ASA
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	POWER SUPPLY	PS873	GRY	VON
1	EA	DOOR POSITION SWITCH	679-05		SCE
1	EA	PROX READER	PROX READER BY SECURITY INTEGRATOR		B/O

HW SET: 09
DOOR NUMBER:
127A

EACH TO HAVE:

3	EA	HINGE	5BB1HW 5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	98L 996L 4'	626	VON
1	EA	RIM CYLINDER	RIM CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 SCUSH TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 10

DOOR NUMBER:
131

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	CL3351 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 11
DOOR NUMBER:
133 227 327

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	CL3355 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 12
DOOR NUMBER:
128 129

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9496L 06A	626	SCH
1	EA	MORTISE CYLINDER	MORTISE CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	DBL WARDROBE HOOK	582	626	IVE

HW SET: 13
DOOR NUMBER:
229 329

EACH TO HAVE:

6	EA	POCKET PIVOT	91105F	630	IVE
1	SET	AUTO FLUSH BOLT	FB42	630	IVE
1	EA	CLASSROOM LOCK	CL3355 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	COORDINATOR	COR X FL X BRACKETS AS REQ'D	628	IVE
1	SET	ASTRAGAL	9605A 84"	AL	NGP
2	EA	SURFACE CLOSER	4000T TB	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
2	EA	MAGNETIC HOLD-OPEN	SEM 7850	AL	LCN
1	SET	SEALS	2525B	BRN	NGP

INTERFACE REQUIRED WITH FIRE LIFE SAFETY SYSTEM FOR IMMEDIATE RELEASE OF MAGNETS IN THE EVENT OF A FIRE.

HW SET: 14
DOOR NUMBER:
203 203A 301 301A

EACH TO HAVE:

6	EA	POCKET PIVOT	91105F	630	IVE
1	EA	FIRE EXIT HARDWARE	9827EO-F-LBR	626	VON
1	EA	FIRE EXIT HARDWARE	9827TP-F-LBR	626	VON
1	EA	RIM CYLINDER	RIM CYLINDER BY OWNER (NIC)	626	ASA
1	SET	ASTRAGAL	9605A 84"	AL	NGP
2	EA	SURFACE CLOSER	4000T TB	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
2	EA	MAGNETIC HOLD-OPEN	SEM 7850	AL	LCN
1	SET	SEALS	2525B	BRN	NGP

COORDINATE LOCATION OF MAGNETS ON THE BOTTOM LEADING EDGE OF THE DOOR WITH ELECTRICAL.

INTERFACE REQUIRED WITH FIRE LIFE SAFETY SYSTEM FOR IMMEDIATE RELEASE OF MAGNETS IN THE EVENT OF A FIRE.

HW SET: 15
DOOR NUMBER:
227A 311 327A

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA

1	EA	SURFACE CLOSER	4041 SHCUSH TB	689	LCN
3	EA	SILENCER	SR64	GRY	IVE
1	EA	DOOR POSITION SWITCH	679-05 (DOOR 311 ONLY)		SCE

HW SET: AL-01
DOOR NUMBER:
100A 200A

EACH TO HAVE:

2	EA	POWER TRANSFER	EPT-10	689	VON
2	EA	CONTINUOUS HINGE	112HD EPT	628	IVE
1	EA	PANIC HARDWARE	RX-XP98EO	626	VON
1	EA	PANIC HARDWARE	ELXP-RX-LX-98TP X 990TP	626	VON
1	EA	RIM CYLINDER	RIM CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA X 18PA TB	689	LCN
1	EA	AUTO-EQUALIZER	4642 REG FC CS	689	LCN
2	EA	OVERHEAD STOP	100S-ADJ	630	GLY
1	EA	POWER SUPPLY	PS873-2	GRY	VON
1			POINT TO POINT WIRING DIAGRAM		LCN
2	EA	DOOR POSITION SWITCH	679-05		SCE
2	EA	ACTUATOR, WALL MOUNT	8310-853		LCN
1	EA	PROX READER	PROX READER BY SECURITY INTEGRATOR		B/O
1			THRESHOLD AND PERIMETER SEAL BY DOOR MFG		B/O

ENTRY BY CARD READER. USER PRESENTS CREDENTIAL, EXIT DEVICE LATCH RETRACTS AND USER OPENS DOOR. HANDICAPPED USERS CREDENTIAL TO ACT AS ACTUATOR FOR ENTRANCE. HANDICAPPED USER PRESENTS CREDENTIAL, EXIT DEVICE LATCH RETRACTS AND AUTO OPERATOR OPENS DOOR. LX SWITCH IN EXIT DEVICE IS WIRED IN SERIES WITH EXTERIOR ACTUATOR TO ENABLE AND DISABLE ACTUATOR. AUTO OPERATOR FUNCTIONS IN CONCERT WITH INTERIOR OPERATOR. DOOR POSITION IS MONITORED BY SECURITY SYSTEM. COORDINATE LOCATION OF ACTUATORS WITH ARCHITECT.

HW SET: AL-02
DOOR NUMBER:
100 200B

EACH TO HAVE:

2	EA	CONTINUOUS HINGE	112HD	628	IVE
2	EA	DUMMY TOUCH BAR	350	626	VON
2	EA	DUMMY PULLS	990DT	626	VON
1	EA	SURFACE CLOSER	4041 EDA X 18PA TB	689	LCN
1	EA	AUTO-EQUALIZER	4642 REG FC CS	689	LCN

2	EA	OVERHEAD STOP	100S-ADJ	630	GLY
1	EA	ACTUATOR, JAMB MOUNT	8310-818		LCN
1			PERIMETER SEAL BY DOOR MFG		B/O

AUTO OPERATOR FUNCTIONS IN CONCERT WITH EXTERIOR OPERATOR. COORDINATE LOCATION OF ACTUATORS WITH ARCHITECT.

HW SET: AL-03
DOOR NUMBER:
199A 199D

EACH TO HAVE:

1	EA	POWER TRANSFER	EPT-10	689	VON
1	EA	CONTINUOUS HINGE	112HD EPT	628	IVE
1	EA	PANIC HARDWARE	RX-XP98EO	626	VON
1	EA	SURFACE CLOSER	4041 EDA X 18PA TB	689	LCN
1	EA	OVERHEAD STOP	100S-ADJ	630	GLY
1	EA	DOOR POSITION SWITCH	679-05		SCE
1			THRESHOLD AND PERIMETER SEAL BY DOOR MFG		B/O

DOOR POSITION MONITORED BY SECURITY SYSTEM. REQUEST TO EXIT IN EXIT DEVICE FOR AUTHORIZED EXITING.

HW SET: R-1
DOOR NUMBER:

104	106	108	110	112	114
135	136	137	140	142	204
206	208	210	212	214	220
222	224	226	232	234	235
238	240	304	306	308	310
312	314	316	318	320	322
324	326	334	336	337	340
342					

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	MAGNETIC HOLD-OPEN	SEM 7850	AL	LCN
1	SET	SEALS	2525B	BRN	NGP
1	EA	VIEWER	U698	626	IVE

ADA RESIDENT ROOMS 106, 137,206, 235, 306, 337 TO BE ROUGHED IN FOR ELECTRIC

STRIKE, ADA OPERATOR, AND ADA ACTUATORS.

INTERFACE REQUIRED WITH FIRE LIFE SAFETY FOR HOLD OPEN RELEASE.

HW SET: R-1.1
DOOR NUMBER:

108F	208F	230F	308F	332F

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	VIEWER	U698	626	IVE

HW SET: R-1.2
DOOR NUMBER:

230	332

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SENTRONIC CLOSER	4040SE 24V	689	LCN
1	SET	SEALS	2525B	BRN	NGP
1	EA	VIEWER	U698	626	IVE

INTERFACE REQUIRED WITH FIRE LIFE SAFETY FOR CLOSER HOLD OPEN RELEASE.

HW SET: R-2
DOOR NUMBER:

104D	104E	106D	108D	108E	110D
110E	112D	112E	114D	114E	135D
135E	136A	137A	140D	140E	142D
142E	204D	204E	206D	208D	208E
210D	210E	212D	212E	214D	214E
216D	216E	218D	218E	220D	220E
222D	222E	224D	224E	226D	226E
230D	230E	232D	232E	234A	235A
238D	238E	240D	240E	304D	304E
306D	308D	308E	310D	310E	312D
312E	314D	314E	316D	316E	318D
318E	320D	320E	322D	322E	324D
324E	326D	326E	332D	332E	334D

334E	336A	337A	340D	340E	342D
342E					

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY SET	CL3320 NZD	626	C-R
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: R-3
DOOR NUMBER:

104A	104B	106A	106B	108A	108B
110A	110B	112A	112B	114A	114B
135A	135B	136B	140A	140B	142A
142B	204A	204B	206A	206B	208A
208B	210A	210B	212A	212B	214A
214B	216A	216B	218A	218B	220A
220B	222A	222B	224A	224B	226A
226B	230A	230B	232A	232B	234B
238A	238B	240A	240B	304A	304B
306A	306B	308A	308B	310A	310B
312A	312B	314A	314B	316A	316B
318A	318B	320A	320B	322A	322B
324A	324B	326A	326B	332A	332B
334A	334B	336B	340A	340B	342A
342B					

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	CL3351 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: R-4
DOOR NUMBER:

104C	106C	108C	110C	112C	114C
135C	137B	140C	142C	204C	206C
208C	210C	212C	214C	216C	218C
220C	222C	224C	226C	230C	232C
235B	238C	240C	304C	306C	308C
310C	312C	314C	316C	318C	320C
322C	324C	326C	332C	334C	337B
340C	342C				

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	CL3310 NZD	626	C-R
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 01
DOOR NUMBER:
222A 222B 224B-W

EACH TO HAVE:

1	EA	CYLINDER	CYLINDER AS REQ'D BY OWNER (NIC)	626	ASA
1			REMAINING HARDWARE BY DOOR MFG		

HW SET: 02
DOOR NUMBER:

100C	100D	100E	100F	100G	100J
100K	100N	100P	100Q	200C	200D
200E	200F	200G	200K	200N	200Q
300C	300D	300E	300F	300G	300K
300N	300P	300Q			

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 SCUSH TB	689	LCN
1	SET	SEALS	2525B	BRN	NGP

HW SET: 03
DOOR NUMBER:
113 116 119 124B

EACH TO HAVE:

3	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 04
DOOR NUMBER:
100H 200H 200P 300H

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELEC HINGE	TEF10C 4.5 X 4.5	652	MAR
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	ELECTRONIC LOCK	AD-300-CY-70-MG-RHO-LD (BY SECURITY INT)	626	SCE
1	EA	SURFACE CLOSER	4041 SCUSH TB	689	LCN

1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1			POWER SUPPLY BY SECURITY INTEGRATOR		
1	EA	INTERFACE BOARD	REF MISC SET FOR PANEL INTERFACE BRD (BY SEC. INT)		

ENTRY BY CARD READER. USER PRESENTS CREDENTIAL, LOCKSET LEVER RELEASES AND USER OPENS DOOR. DOOR POSITION SWITCH AND REX IS LOCATED IN LOCKSET.

HW SET: 05
DOOR NUMBER:
109 209 309

EACH TO HAVE:

6	EA	POCKET PIVOT	91105F	630	IVE
1	SET	AUTO FLUSH BOLT	FB42	630	IVE
1	EA	CLASSROOM LOCK	CL3355 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	COORDINATOR	COR X FL X BRACKETS AS REQ'D	628	IVE
1	SET	ASTRAGAL	9605A 84"	AL	NGP
2	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
2	EA	MAGNETIC HOLD-OPEN	SEM 7850	AL	LCN
1	SET	SEALS	2525B	BRN	NGP

HW SET: 06
DOOR NUMBER:
129 229 329

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	CL3355 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	MAGNETIC HOLD-OPEN	SEM 7850	AL	LCN
1	SET	SEALS	2525B	BRN	NGP

HW SET: 07
DOOR NUMBER:

199A	199B-S	199C-S	199D-S	199E-S	199F-E
299A	299B	299C	299D	299E	299F
399A	399B	399C	399D	399E	399F

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	98L-BE-F 996L-BE 499F	626	VON

1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 08
DOOR NUMBER:
322-N

EACH TO HAVE:

6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	MULLION	KR4954	689	VON
2	EA	PANIC HARDWARE	98L 996L 3'	626	VON
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	MORTISE CYLINDER	MORTISE CYLINDER BY OWNER (NIC)	626	ASA
2	EA	RIM CYLINDER	RIM CYLINDER BY OWNER (NIC)	626	ASA
2	EA	SURFACE CLOSER	4041 HEDA X 18PA TB	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
2	EA	WALL STOP	WS407CCV	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

HW SET: 09
DOOR NUMBER:
100A 121 200A 300A

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 10
DOOR NUMBER:
122 333

EACH TO HAVE:

2	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELEC HINGE	TEF10C 4.5 X 4.5	652	MAR
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	ELECTRONIC LOCK	AD-300-CY-70-MG-RHO-LD (BY SECURITY INT)	626	SCE
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE

3	EA	SILENCER	SR64	GRY	IVE
1	EA	INTERFACE BOARD	REF MISC SET FOR PANEL INTERFACE BRD (BY SEC. INT)		

HW SET: 11
DOOR NUMBER:
124A

EACH TO HAVE:

6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
2	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
2	EA	WALL STOP	WS407CCV	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

HW SET: 12
DOOR NUMBER:
137E 200B 300B

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 13
DOOR NUMBER:
136A

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 14
DOOR NUMBER:
322A-1 322A-2 322A-3 322A-4

EACH TO HAVE:

6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	CLASSROOM LOCK	CL3355 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
2	EA	OVERHEAD HOLDER	450H	630	GLY
2	EA	SILENCER	SR64	GRY	IVE

HW SET: 15
DOOR NUMBER:
222D 224B-S 224D 334 335 336

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	CL3355 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 16
DOOR NUMBER:
224A 224E 224F

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	CL3355 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 17
DOOR NUMBER:
133 134 137A 137B 137C 137D
137F 137G 137H

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	CL3351 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 18
DOOR NUMBER:
102B 202A 202B 202C 302A 302B
302C

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9496L 06A L583-363	626	SCH
1	EA	MORTISE CYLINDER	MORTISE CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	EA	DBL WARDROBE HOOK	582	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 19
DOOR NUMBER:
102A 102C

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9496L 06A L583-363	626	SCH
1	EA	MORTISE CYLINDER	MORTISE CYLINDER BY OWNER (NIC)	626	ASA
1	EA	ELECTRIC STRIKE	6216 FS 24VDC	630	VON
1	EA	AUTO-EQUALIZER	4631 REG	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	EA	DBL WARDROBE HOOK	582	626	IVE
3	EA	SILENCER	SR64	GRY	IVE
2	EA	ACTUATOR, WALL MOUNT	8310-853		LCN

USER PUSHES ACTUATOR, ELECTRIC STRIKE RELEASES, AUTO OPERATOR OPENS DOOR. USER ENTERS AND TURNS DEADBOLT FOR PRIVACY. IF SOMEONE DEPRESSES ACTUATOR WHILE RESTROOM IS OCCUPIED, ELECTRIC STRIKE RELEASES, BUT DEADBOLT DOES NOT ALLOW ENTRY. AUTO OPERATOR TIMES OUT. TO EXIT, USER RELEASES DEADBOLT, PUSHES ACTUATOR AND AUTO OPERATOR OPENS DOOR TO EXIT.

HW SET: 20
DOOR NUMBER:
100L 100M 200J 200M 300L 300M

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT-10	689	VON

1	EA	FIRE EXIT HARDWARE	98EO-F	626	VON
1	EA	ELECTRONIC EXIT TRIM	AD-300-993R-70-MG-RHO-PD (BY SEC. INTEGRATOR)	626	SCE
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	INTERFACE BOARD	REF MISC SET FOR PANEL INTERFACE BRD (BY SEC. INT)		

HW SET: 21
DOOR NUMBER:
322-S

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	98L 996L 3'	626	VON
1	EA	RIM CYLINDER	RIM CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 HEDA TB	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: AL-01
DOOR NUMBER:
101B 201A

EACH TO HAVE:

2	EA	POWER TRANSFER	EPT-10	689	VON
2	EA	CONTINUOUS HINGE	112HD EPT	628	IVE
1	EA	MULLION	KR4954	689	VON
1	EA	PANIC HARDWARE	RX-XP98EO	626	VON
1	EA	PANIC HARDWARE	ELXP-RX-LX-98NL X VR910NL	626	VON
1	EA	MORTISE CYLINDER	MORTISE CYLINDER BY OWNER (NIC)	626	ASA
1	EA	RIM CYLINDER	RIM CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA X 18PA TB	689	LCN
1	EA	AUTO-EQUALIZER	4642 REG FC CS	689	LCN
2	EA	OVERHEAD STOP	100S-ADJ	630	GLY
1	EA	THRESHOLD	350	AL	NGP
1			POINT TO POINT WIRING DIAGRAM		LCN
2	EA	DOOR POSITION SWITCH	679-05		SCE
2	EA	ACTUATOR, WALL MOUNT	8310-853		LCN
1	EA	RELAY BOARD	900-2RS		VON
1	EA	MAG STRIPE READER	LNL2005WBK (BY SECURITY INTEGRATOR)		LNL
1	EA	POWER SUPPLY	PS914 X 9002-RS	GRY	VON

1 PERIMETER SEAL DOOR MFG STD

ENTRY BY CARD READER. USER PRESENTS CREDENTIAL, EXIT DEVICE LATCH RETRACTS AND USER OPENS DOOR. HANDICAPPED USERS CREDENTIAL TO ACT AS ACTUATOR FOR ENTRANCE. HANDICAPPED USER PRESENTS CREDENTIAL, EXIT DEVICE LATCH RETRACTS AND AUTO OPERATOR OPENS DOOR. LX SWITCH IN EXIT DEVICE IS WIRED IN SERIES WITH EXTERIOR ACTUATOR TO ENABLE AND DISABLE ACTUATOR. AUTO OPERATOR FUNCTIONS IN CONCERT WITH INTERIOR OPERATOR. DOOR POSITION IS MONITORED BY SECURITY SYSTEM. COORDINATE LOCATION OF ACTUATORS WITH ARCHITECT.

HW SET: AL-02
DOOR NUMBER:
101A 201B

EACH TO HAVE:

2	EA	CONTINUOUS HINGE	112HD	628	IVE
2	EA	DUMMY TOUCH BAR	350	626	VON
2	EA	DOOR PULL	8105-8	630	IVE
1	EA	SURFACE CLOSER	4041 EDA X 18PA TB	689	LCN
1	EA	AUTO-EQUALIZER	4642 REG FC CS	689	LCN
2	EA	OVERHEAD STOP	100S-ADJ	630	GLY
1	EA	THRESHOLD	350	AL	NGP
1	EA	ACTUATOR, JAMB MOUNT	8310-818		LCN
1			PERIMETER SEAL BY DOOR MFG		

AUTO OPERATOR FUNCTIONS IN CONCERT WITH EXTERIOR OPERATOR. COORDINATE LOCATION OF ACTUATORS WITH ARCHITECT.

HW SET: AL-03
DOOR NUMBER:
199B-N 199C-N 199D-N 199E-N 199F-W

EACH TO HAVE:

1	EA	POWER TRANSFER	EPT-10	689	VON
1	EA	CONTINUOUS HINGE	112HD EPT	628	IVE
1	EA	PANIC HARDWARE	RX-XP98EO	626	VON
1	EA	SURFACE CLOSER	4041 EDA X 18PA TB	689	LCN
1	EA	OVERHEAD STOP	100S-ADJ	630	GLY
1	EA	DOOR POSITION SWITCH	679-05		SCE
1			THRESHOLD & PERIMETER SEAL DOOR MFG STD		

DOOR POSITION MONITORED BY SECURITY SYSTEM. REQUEST TO EXIT IN EXIT DEVICE FOR

AUTHORIZED EXITING.

HW SET: AL-04
DOOR NUMBER:
128E-S 201C 201D 224G

EACH TO HAVE:

1	EA	POWER TRANSFER	EPT-10	689	VON
1	EA	CONTINUOUS HINGE	112HD EPT	628	IVE
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	ELECTRONIC LOCK	AD-300-CY-70-MG-RHO-LD (BY SECURITY INT)	626	SCE
1	EA	SURFACE CLOSER	4041 EDA X 18PA TB	689	LCN
1	EA	OVERHEAD STOP	100S-ADJ	630	GLY
1			POWER SUPPLY BY SECURITY INTEGRATOR		
1	EA	INTERFACE BOARD	REF MISC SET FOR PANEL INTERFACE BRD (BY SEC. INT)		
1			THRESHOLD & PERIMETER SEAL DOOR MFG STD		

ENTRY BY CARD READER. USER PRESENTS CREDENTIAL, LOCKSET LEVER RELEASES AND USER OPENS DOOR. DOOR POSITION SWITCH AND REX IS LOCATED IN LOCKSET.

HW SET: AL-05
DOOR NUMBER:
137-N

EACH TO HAVE:

1	EA	CONTINUOUS HINGE	112HD	628	IVE
1	EA	ENTRANCE LOCK	CL3351 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA X 18PA TB	689	LCN
1	EA	WALL STOP	WS407CCV	630	IVE
1			PERIMETER SEAL DOOR MFG STD		

HW SET: AL-06
DOOR NUMBER:
136-E 136-W 224B-N

EACH TO HAVE:

1	EA	CONTINUOUS HINGE	112HD	628	IVE
1	EA	CLASSROOM LOCK	CL3355 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA X 18PA TB	689	LCN
1	EA	WALL STOP	WS407CCV	630	IVE
1			PERIMETER SEAL DOOR MFG STD		

HW SET: AL-07
DOOR NUMBER:
123

EACH TO HAVE:

2	EA	CONTINUOUS HINGE	112HD	628	IVE
2	EA	MANUAL FLUSH BOLT	FB358	626	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	ELECTRONIC LOCK	AD-300-CY-70-MG-RHO-LD (BY SECURITY INT)	626	SCE
1	EA	SURFACE CLOSER	4041 EDA X 18PA TB (ACTIVE LEAF ONLY)	689	LCN
1	EA	OVERHEAD STOP	100S-ADJ	630	GLY
1	EA	WALL STOP	WS407CCV	630	IVE
1			PERIMETER SEAL DOOR MFG STD		
1	EA	INTERFACE BOARD	REF MISC SET FOR PANEL INTERFACE BRD (BY SEC. INT)		

HW SET: AL-08
DOOR NUMBER:
137-S

EACH TO HAVE:

1	EA	CONTINUOUS HINGE	112HD	628	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA X 18PA TB	689	LCN
1	EA	OVERHEAD STOP	100S-ADJ	630	GLY
1			THRESHOLD & PERIMETER SEAL DOOR MFG STD		

HW SET: R-1
DOOR NUMBER:

104	105	107	108	110	111
112	114	115	116ALT	117	118
120	126	130	131	204	205
207	208	210	211	212	213
214	215	216	217	218	219
220	226	227	228	230	231
304	305	307	308	310	311
312	313	314	315	316	317
318	319	320	326	327	328
330	331				

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE

1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	MAGNETIC HOLD-OPEN	SEM 7850	AL	LCN
1	SET	SEALS	2525B	BRN	NGP
1	EA	VIEWER	U698	626	IVE

INTERFACE REQUIRED WITH FIRE LIFE SAFETY FOR MAG HOLD OPEN RELEASE.

HW SET: R-2
DOOR NUMBER:
127 128

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	CL3357 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	SURFACE CLOSER	4041 EDA TB	689	LCN
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	VIEWER	U698	626	IVE

HW SET: R-3
DOOR NUMBER:

104C	104D	105C	105D	107C	107D
108C	108D	110C	110D	111C	111D
112D	112E	114D	114E	115D	115E
116D	116E	117D	117E	118D	120D
120E	126D	126E	127B	128C	128G
130C	130D	131C	131D	204C	204D
205C	205D	207C	207D	208C	208D
210C	210D	211C	211D	212D	212E
213D	213E	214D	214E	215D	215E
216D	216E	217D	217E	218D	219D
219E	220D	220E	226D	226E	227D
227E	228D	228E	230C	230D	231C
231D	304C	304D	305C	305D	307C
307D	308C	308D	310C	310D	311C
311D	312D	312E	313D	313E	314D
314E	315D	315E	316D	316E	317D
317E	318D	319D	319E	320D	320E
326D	326E	327D	327E	328D	328E
330C	330D	331C	331D		

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY SET	CL3320 NZD	626	C-R
1	EA	WALL STOP	WS407CCV	630	IVE

3	EA	SILENCER	SR64	GRY	IVE

HW SET: R-4
DOOR NUMBER:

104A	104B	105A	105B	107A	107B
108A	108B	110A	110B	111A	111B
112A	112B	112C	114A	114B	114C
115A	115B	115C	116A	116B	116C
117A	117B	117C	118A	118B	118C
120A	120B	120C	126A	126B	126C
127A	128D	128F	130A	130B	131A
131B	204A	204B	205A	205B	207A
207B	208A	208B	210A	210B	211A
211B	212A	212B	212C	213A	213B
213C	214A	214B	214C	215A	215B
215C	216A	216B	216C	217A	217B
217C	218A	218B	218C	219A	219B
219C	220A	220B	220C	226A	226B
226C	227A	227B	227C	228A	228B
228C	230A	230B	231A	231B	304A
304B	305A	305B	307A	307B	308A
308B	310A	310B	311A	311B	312A
312B	312C	313A	313B	313C	314A
314B	314C	315A	315B	315C	316A
316B	316C	317A	317B	317C	318A
318B	318C	319A	319B	319C	320A
320B	320C	326A	326B	326C	327A
327B	327C	328A	328B	328C	330A
330B	331A	331B			

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	CL3351 NZD	626	C-R
1	EA	K-I-L CYLINDER	KEY-IN-LEVER CYLINDER BY OWNER (NIC)	626	ASA
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: R-5
DOOR NUMBER:

128A	128E-N

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	CL3310 NZD	626	C-R
1	EA	WALL STOP	WS407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: R-6
DOOR NUMBER:
127C 128B

EACH TO HAVE:

6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
2	EA	SGL DUMMY TRIM	CL3350 NZD	626	C-R
2	EA	ROLLER LATCH	RL32 (TOP MOUNT)	626	IVE
2	EA	WALL STOP	WS407CCV	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

MISC ITEMS

9	EA	INTERFACE BOARD	PIB300-2D (BY SECURITY INT)	SCE

SECTION 088000 - GLASS AND GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY:

A. Extent of glass and glazing work is indicated on drawings and schedules.

B. Types of glass and glazing work include the following:

1. Curtainwall construction.
2. Storefront Entrances and other doors.
3. Fire Rated glazing

1.3 SYSTEM DESCRIPTION:

A. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.

1. Normal thermal movement is defined as that resulting from an ambient temperature range of 120 deg. F (67 deg. C) and from a consequent temperature range within glass and glass framing members of 180 deg. F (100 deg. C).
2. Deterioration of insulating glass is defined as failure of hermetic seal due to other causes than breakage which results in intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coating, if any, resulting from seal failure, and any other visual evidence of seal failure or performance.

1.4 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. LEED Submittals:

1 Product Data for Credit IEQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.

C. Glass Samples: For each type of **glass product other than clear monolithic vision glass** ; 12 inches (300 mm) square.

D. Glazing Accessory Samples: For **gaskets sealants and colored spacers**, in 12-inch (300-mm) lengths. **Install sealant Samples between two strips of material representative in color of the adjoining framing system.**

E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

G. Qualification Data: For [installers] [manufacturers of insulating-glass units with sputter-coated, low-e coatings] [glass testing agency] [and] [sealant testing agency].

H. Product Certificates: For glass and glazing products, from manufacturer.

I Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for **insulating glass glazing sealants and glazing gaskets**.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

J. Preconstruction adhesion and compatibility test report.

K. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE:

A. Glazing Standards: Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or other referenced standards.

B. Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials.

1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

C. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component pane of units with appropriate certification label of inspecting and testing organization indicated below:

1. Insulating Glass Certification Council (IGCC).

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes.

1. Where insulating glass units will be exposed to substantial altitude changes, avoid hermetic seal ruptures by complying with insulating glass fabricator's recommendations for venting and sealing.

1.7 PROJECT CONDITIONS:

A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other causes.

1. Install liquid sealants at ambient and substrate temperatures above 40 deg. F (4.4 deg. C).

1.8 WARRANTY:

A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

B. Manufacturer's Special Project Warranty on Insulating Glass: Provide written warranty signed by manufacturer of insulating glass agreeing to furnish f.o.b. point of manufacture, freight allowed project site, within specified warranty period indicated below, replacements for those insulating glass units developing manufacturing defects. Manufacturing defects are defined as failure or hermetic seal of air space (beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coatings, if any, and other visual indications of seal failure or performance; provided the manufacturer's instructions for handling, installing, protecting and maintaining units have been complied with during the warranty period.

1. Warranty Period: Manufacturer's standard but not less than 10 years after date of substantial completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL:

A. Primary Glass Standard: Provide primary glass which complies with ASTM C 1036 requirements, including those indicated by reference to type, class, quality, and, if applicable, form, finish, mesh and pattern.

B. Heat-Treated Glass Standard: Provide heat-treated glass which complies with ASTM C 1048 requirements, including those indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish, and pattern.

C. Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.

2.2 PRIMARY GLASS PRODUCTS:

A. Clear Float Glass: Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select).

2.3 HEAT-TREATED GLASS PRODUCTS:

A. Manufacturing Process: Manufacture heat-treated glass as follows:

1. By horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated.

B. Uncoated Clear Heat-Treated Float Glass: Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below.

1. Kind FT (fully tempered).

2.4 COATED GLASS PRODUCTS:

A. Provide Kind HS (heat-strengthened) coated float glass in place of coated annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article. Provide Kind FT (fully tempered) where safety glass is indicated.

1. Provide Kind HS (heat-strengthened) coated float glass, except provide Kind FT (fully tempered) products where coated safety glass is indicated.

B Coated Float Glass: Float glass with low emissivity coating deposited during manufacturing process, complying with requirements specified in schedules at the end of Part 3.
.

2.5 SEALED INSULATING GLASS UNITS:

A. General: Provide preassembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E 774 for performance classification indicated as well as with other requirements specified for glass characteristics, air space, sealing system, sealant, spacer material, corner design and dessicant.

1. For properties of individual glass panes making up units, refer to product requirements specified elsewhere in this section applicable to types, classes, kinds and conditions of glass products indicated.
2. Provide heat-treated panes of kind and at locations indicated or, if not indicated, provide heat-strengthened panes where recommended by manufacturer for application indicated and tempered where indicated or where safety glass is designated or required.
3. Performance Classification per ASTM E 774: Class A.

    a. Thickness of Each Pane: 1/4".
    b. Air Space Thickness: 1/2".
    c. Sealing System: Dual seal; primary and secondary sealant: manufacturer's standard materials except secondary sealant to be silicone.
    d. Spacer Material: Aluminum.

4. Dessicant: Manufacturer's standard; either molecular sieve or silica gel or blend of both.
5. Corner Construction: Manufacturer's standard corner construction.

B. Insulating Glass Units: Manufacturer's standard units complying with the following requirements:

1. Exterior Pane: Tinted with Low E coating on 2rd Surface
2. Interior Pane: Clear .

2.6 FIRE-RATED GLAZING PRODUCTS

A. Laminated Glass with Intumescent Interlayers: Proprietary Category II safety glazing product in the form of multiple lites of Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Kind FT (fully tempered) float glass laminated with intumescent interlayers; for level of optical clarity matching non fire rated glass in the finished application and as follows:

1. Fire-Protection Rating: 45 **minutes**, hose stream tested and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

2. Product: Subject to compliance with requirements,

ContraFlam 45 Saint Gobain Glass Products

Super Lite II XL – 45 min

2.7 ELASTOMERIC GLAZING SEALANTS:

A. General: Provide products of type indicated and complying with the following requirements:

1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials with which they will come into contact, including glass products, seals of

insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

2. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.
3. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.
4. Colors: Provide color of exposed sealants indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

B. One-Part Non-Acid-Curing Silicone Glazing Sealant: Type S; Grade NS, Class 25; Uses NT, G, A, and, as applicable to uses indicated, O; and complying with the following requirements for modulus and additional joint movement capability.

1. Medium Modulus: Tensile strength of not less than 45 nor more than 75 psi at 100 percent elongation when tested per ASTM D 412 after 14 days at 77 deg. F (20 deg. C) and 50 percent relative humidity.

C. Products: Subject to compliance with requirements, provide one of the following:

1. One-Part Non-Acid Curing Medium-Modulus Silicone Glazing Sealant:

a. "Dow Corning 795"; Dow Corning Corp.
b. "Silpruf"; General Electric Corp.
c. "Spectrum 2"; Tremco, Inc.

2.8 MISCELLANEOUS GLAZING MATERIALS:

A. Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

C. Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.

D. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.

E. Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.

F. Compressible Filler Rods: Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5-10 psi compression strength for 25 percent deflection.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Require Glazier to inspect work of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Obtain Glazier's written report listing conditions detrimental to performance of glazing work. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Pre-Installation Meeting: At Contractor's direction, Glazier, sealant and gasket manufacturers' technical representatives, glass framing erector and other trades whose work affects glass and glazing shall meet at project site to review procedures and time schedule proposed for glazing and coordination with other work.

B. Clean glazing channels and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

3.3 GLAZING, GENERAL:

A. Comply with combined printed recommendations of glass manufacturers, of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.

B. Glazing channel dimensions as indicated in details are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.

C. Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants.

3.4 GLAZING:

A. Install setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6" from corner, unless otherwise required. Set blocks in thin course of sealant which is acceptable for heel bead use.

B. Provide spacers inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where

gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

C. Provide edge blocking to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.

D. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

E. Provide compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers, to prevent sealant from extruding into glass channel weep systems and from adhering to joints back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.

F. Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

G. Tool exposed surfaces of sealants to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.

H. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement.

I. Miter cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.5 PROTECTION AND CLEANING:

A. Protect exterior glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.

C. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

D. Wash glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Wash glass by method recommended by glass manufacturer.

3.6 INSULATING GLASS SCHEDULE

A. Glass Type 1 aand Type 2 tempered: Low-e-coated, tinted insulating glass.

1. Basis of Design: PPG Solarban 60; “Atlantica”;

a. Overall Unit Thickness: 1 inch (25 mm).
b. Thickness of Each Glass Lite: 6.0 mm.
c. Outdoor Lite: Tinted heat-strengthened float glass.
d. Interspace Content: Air.
e. Indoor Lite: Clear heat-strengthened float glass.
f. Low-E Coating: Sputtered on third surface.
g. Visible Light Transmittance: 52 percent minimum.
h. Winter Nighttime U-Factor: 0.29 maximum.
i. Summer Daytime U-Factor: 0.28 maximum.
j. Solar Heat Gain Coefficient: 0.31 maximum.

k. Coated Clear Fully Tempered Float Glass : Condition C (other coated glass), Kind FT (fully tempered) at areas in line of egress and /or subject to impact.

B. Glass Type 1A: Low-e-coated, tinted insulating glass.

1. Basis of Design: PPG Solarban 70XL; “Atlantica”; west exposures.

2. Overall Unit Thickness: 1 inch (25 mm).
3. Thickness of Each Glass Lite: 6.0 mm.
4. Outdoor Lite: Tinted heat-strengthened float glass.
5. Interspace Content: Air.
6. Indoor Lite: Clear heat-strengthened float glass.
7. Low-E Coating: Sputtered on third surface.
8. Visible Light Transmittance: 49 percent minimum.
9. Winter Nighttime U-Factor: 0.29 maximum.
10. Summer Daytime U-Factor: 0.27 maximum.
11. Solar Heat Gain Coefficient: 0.28 maximum.

c. Glass Type 3: Ceramic-coated, low-e, insulating spandrel glass.

1. Basis of Design: Match PPG Solarban 60; “Atlantica”;

2. Overall Unit Thickness: 1 inch (25 mm).
3. Thickness of Each Glass Lite: 6.0 mm.
4. Outdoor Lite: Heat strengthened float glass.
5. Interspace Content: Air.
6. Indoor Lite: Heat-strengthened float glass.
7. Low-E Coating: Sputtered on third surface.
8. Opaque Coating Location: Fourth surface. In color as selected by Architect

END OF SECTION 088000

SECTION 092115 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Nonload-bearing steel framing members for gypsum board assemblies.
2. Gypsum board assemblies attached to steel framing. Abuse Resistant Throughout

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section “Sustainable Design Requirements” for IEQ Credits 4.1, MR Credits 4 and 5.

2. Division 5 Section "Cold-Formed Metal Framing" for load-bearing steel framing.
3. Division 6 Section “Panel Sheathing” for glass faced gypsum sheathing and division 6 Section for blocking.
4. Division 7 Section "Firestopping" for firestopping systems and fire-resistance-rated joint sealants.
5. Division 9 Sections for Gypsum fabrications.

1.3 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 ASSEMBLY PERFORMANCE REQUIREMENTS

A. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

B. Fire Resistance: Provide gypsum board assemblies with fire-resistance ratings indicated.

1.5 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. LEED Submittal:

1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

D. Shop Drawings showing locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work. Locations of abuse resistant gypsum panels where applicable.

E. Product certificates signed by manufacturers of gypsum board assembly components certifying that their products comply with specified requirements.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.

B. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

C. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

D. Fire-Test-Response Characteristics: Where fire-resistance-rated gypsum board assemblies are indicated, provide gypsum board assemblies that comply with the following requirements:

1. Fire-Resistance Ratings: As indicated by GA File Numbers in GA-600 "Fire Resistance Design Manual" or design designations in UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Gypsum board assemblies indicated are identical to assemblies tested for fire resistance according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
3. Deflection and Firestop Track: Top runner provided in fire-resistance-rated assemblies indicated is labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

1.8 PROJECT CONDITIONS

A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.

B. Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F (10 deg C) for 48 hours before application and continuously after until dry. Do not exceed 95 deg F (35 deg C) when using temporary heat sources.

C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Steel Framing and Furring:

   a. Clark Steel Framing, Inc.
   b. Consolidated Systems, Inc.
   c. Dale Industries, Inc.
   d. Dietrich Industries, Inc.
   e. Marino/Ware (formerly Marino Industries Corp.).
   f. National Gypsum Co.; Gold Bond Building Products Division.
   g. SCAFCO Steel Stud Manufacturing Co.
   h. Unimast, Inc.

2. Grid Suspension Assemblies:

   a. Armstrong World Industries, Inc.
   b. Chicago Metallic Corp.
   c. USG Interiors, Inc.
   d. Worthington Steel Company (formerly National Rolling Mills).

3. Gypsum Board and Related Products:

   a. Domtar Gypsum.
   b. Georgia-Pacific Corp.
   c. National Gypsum Co.; Gold Bond Building Products Division.
   d. Pacific Building Products, Inc.
   d United States Gypsum Co.

2.2 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

A. General: Provide components complying with ASTM C 754 for conditions indicated.

B. Wire Ties: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper, 0.062 inch (1.6 mm) thick.

C. Wire Hangers: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper, 0.162-inch (4.1-mm) diameter.

D. Grid Suspension System for Interior Ceilings: ASTM C 645, manufacturer's standard direct-hung grid suspension system composed of main beams and cross-furring members that interlock to form a modular supporting network.

2.3 STEEL FRAMING FOR WALLS AND PARTITIONS

A. General: Provide steel framing members complying with the following requirements:

1. Protective Coating: ASTM A 653, G 40 (ASTM A 653M, Z 90) hot-dip galvanized coating.

B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch- (5-mm-) wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:

1. Thickness: 0.0396 inch 20 gauge as follows:

a. For head runner, sill runner, jamb, and cripple studs at door and other openings.

2. Depth: As indicated.

C. Deflection Track: Manufacturer's standard top runner designed to prevent cracking of gypsum board applied to interior partitions resulting from deflection of the structure above fabricated from steel sheet complying with ASTM A 653 (ASTM A 653M) or ASTM A 568 (ASTM A 568M). Thickness as indicated for studs, and width to accommodated depth of studs, and of the following configuration:

1. Top runner with 2-1/2-inch- (63.5-mm-) deep flanges that either have V-shaped offsets that compress when pressure is applied from construction above or have slots 1 inch (25.4 mm) o.c. that allow fasteners attached to studs through the slots to accommodate structural movement by slipping.

a. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

1) Superior Flex Track System (SFT); Delta Star, Inc.
2) SLP-TRK; Metal-Lite, Inc.

D. Deflection and Firestop Track: Top runner designed to allow partition heads to expand and contract with movement of structure above while maintaining continuity of the assembly. Comply with requirements of ASTM C 645 except configuration, of thickness indicated for studs and width to accommodate depth of studs indicated with flanges offset at midpoint to accommodate gypsum board thickness.

1. Offset Configuration: As indicated.
2. Available Product: Subject to compliance with requirements, a product that may be incorporated in the Work includes, but is not limited to, "Fire Trak" manufactured by Fire Trak Corp.

E. Steel Rigid Furring Channels: ASTM C 645, hat shaped, depth and minimum thickness of base (uncoated) metal as follows:

1. Thickness: 0.0336 inch (0.84 mm), unless otherwise indicated.
2. Depth: 1-1/2 inch (38.1 mm).

F. Steel Flat Strap Plate: Steel sheet for bracing only complying with ASTM A 653 (ASTM A 653M) or ASTM A 568 (ASTM A 568M), length and width as indicated, and with a minimum base metal (uncoated) thickness as follows:
1. Thickness: 0.0635 inch (1.5 mm) where indicated.
2. Blocking is specified in Division 6 Section.

G. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

2.4 GYPSUM BOARD PRODUCTS

A. General: Provide gypsum board of types indicated in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.

1. Widths: Provide gypsum board in widths of 48 inches (1219 mm).

B. Gypsum Board for Walls and Ceilings:
1. Type: Abuse Resistant and Type X where indicated or required for fire-resistance-rated assemblies.
2. Edges: Manufacturer's standard.
3. Thickness: 5/8 inch (15.9 mm) where indicated.

C. Gypsum Board Base Layer(s) for Multilayer Applications: Gypsum wallboard, ASTM C 36, and as follows:
1. Type: Type X where indicated or required for fire-resistance-rated assemblies.
2. Edges: Manufacturer's standard.
3. Thickness: 5/8 inch (15.9 mm) where indicated.

D. Moisture- and Mold-Resistant , Abuse resistant Type for Wet areas: With moisture- and mold-resistant core and surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.

2.5 TRIM ACCESSORIES

A. Accessories for Interior Installation: Cornerbead, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:

1. Material: Formed metal or plastic, with metal complying with the following requirement:

   a. Steel sheet zinc coated by hot-dip process or rolled zinc.

2. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:

   a. Cornerbead on outside corners, unless otherwise indicated.
   b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.
   c. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead where indicated.
   d. U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use U-bead where indicated.
   e. One-piece control joint formed with V-shaped slot and removable strip covering slot opening.
   f. Slot reveal : ¼ inch profile

B. Accessory for Curved Edges: Cornerbead formed of metal, plastic, or metal combined with plastic, with either notched or flexible flanges that are bendable to curvature radius.

2.6 JOINT TREATMENT MATERIALS

A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.

B. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.

   1. Use paper tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated.

C. Joint Compounds for Gypsum Board - one of the following types may be used at the Contractor's option.

   Setting type Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated.

   1. For taping and filling only, use formulation that is compatible with other joint compounds applied over it.
   2. For prefilling gypsum board joints, use formulation recommended by gypsum board manufacturer.
   3. For filling joints and treating fasteners of water-resistant gypsum backing board behind base for ceramic tile, use formulation recommended by gypsum board manufacturer.
   4. For topping compound, use sandable formulation.

   Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products complying with the following requirements for formulation and intended use.

   1. Ready-Mixed Formulation: Factory-mixed product.

      a. Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.
      b. Topping compound formulated for fill (second) and finish (third) coats.
      c. All-purpose compound formulated for both taping and topping compounds.

2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834, VOC content of less than 50 grams per liter and the following requirements:

1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.8 MISCELLANEOUS MATERIALS

A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel drill screws complying with ASTM C 1002 for the following applications:

1. Fastening gypsum board to steel members less than 0.033 inch (0.84 mm) thick.
2. Fastening gypsum board to gypsum board.

D. Steel drill screws complying with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

E. Steel drill screws of size and type recommended by unit manufacturer for fastening cementitious backer units.

F. Sound-Attenuation Blankets: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing).
1. Mineral-Fiber Type: Fibers manufactured from glass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to

building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.

1. Furnish devices indicated to other trades for installation well in advance of time needed for coordination with other construction.

3.3 INSTALLING STEEL FRAMING, GENERAL

A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with United States Gypsum Co.'s "Gypsum Construction Handbook."
   a. Install deflection track top runner to attain lateral support and avoid axial loading.
   b. Install deflection and firestop track top runner at fire-resistance-rated assemblies where indicated.

      1) Attach jamb studs at openings to tracks using manufacturer's standard stud clip.

C. Do not bridge building control and expansion joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

3.4 INSTALLING STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

A. Suspend ceiling hangers from building structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
4. Secure flat, angle, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or otherwise fail.
5. Do not attach hangers to steel deck tabs.
6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

B. Sway-brace suspended steel framing with hangers used for support.

C. Install suspended steel framing components in sizes and at spacings indicated, but not less than that required by the referenced steel framing installation standard.

1. Wire Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

D. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring or grid suspension members are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) as measured both lengthwise on each member and transversely between parallel members.

E. Wire-tie or clip furring members to main runners and to other structural supports as indicated.

F. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.5 INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.

1. Where studs are installed directly against exterior walls, install asphalt felt strips or foam gaskets between studs and wall.

B. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. For STC-rated and fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.

D. Terminate partition framing at suspended ceilings only where indicated.

E. Install steel studs and furring in sizes and at spacings indicated.

1. Single-Layer Construction: Space studs 16 inches (406 mm) o.c., unless otherwise indicated.
2. Multilayer Construction: Space studs 24 inches (610 mm) o.c., unless otherwise indicated.

F. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.

1. Position studs vertically with open sides facing in same direction and engaging floor and ceiling runners. Begin and end each arc with a stud and space intermediate studs

equally along arcs at stud spacing recommended by gypsum board manufacturer for radii indicated. Attach studs to runners with 3/8-inch- (9.5-mm-) long pan head framing screws. On straight lengths at ends of arcs, place studs 6 inches (150 mm) o.c. with last stud left free standing.

G. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

1. Install 2 studs at each jamb, unless otherwise indicated.
2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint.
3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

H. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

I. Install insulation as follows:

1. Erect insulation vertically and hold in place with friction fit or supplemental clips if required.

3.6 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.

B. Install sound-attenuation blankets, where indicated, prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

E. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Avoid joints other than control joints at corners of framed openings where possible.

F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

G. Attach gypsum panels to framing provided at openings and cutouts.

H. Form control and expansion joints at locations indicated or as required by manufacturer, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.

I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally.

1. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect open structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

J. Isolate perimeter of nonload-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

K. Where STC-rated gypsum board assemblies are indicated, seal construction at perimeters, behind control and expansion joints, openings, and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.

1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.

M. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

3.7 GYPSUM BOARD APPLICATION METHODS

A. Single-Layer Application: Install gypsum wallboard panels as follows:

1. On ceilings, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless parallel application is required for fire-resistance-rated assemblies. Use maximum-length panels to minimize end joints.

   a. Stagger abutting end joints not less than one framing member in alternate courses of board.
   b. At stairwells and other high walls, install panels horizontally.
   c. Install abuse resistant panels to ceiling height with regular core board installed above ceiling line.

B. Wall Tile Substrates: For substrates indicated to receive ceramic tile and similar rigid applied wall finishes, comply with the following:

1. Paperless Gypsum Backing Board: Install where indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
2. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

C. Wet Area walls: install Moisture Resistant core board for areas not subject to direct moisture contact.

D. Multilayer Application on Ceilings: Apply gypsum board indicated for base layers prior to applying base layers on walls/partitions; apply gypsum wallboard face layers in same sequence. Offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints. Apply base layers at right angles to framing members, unless otherwise indicated.

E. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and gypsum wallboard face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints. Stagger joints on opposite sides of partitions.

F. Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:

1. Fasten with screws.

G. Multilayer Fastening Methods: Apply base layers of gypsum panels and face layer to base layers as follows:

1. Fasten both base layers and face layers separately to supports with screws.

3.8 INSTALLING TRIM ACCESSORIES

A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.

B. Install cornerbead at external corners.

C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.

1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
2. Install L-bead where edge trim can only be installed after gypsum panels are installed.
3. Install U-bead where indicated.
4. Install aluminum trim and other accessories where indicated.

D. Install control joints according to ASTM C 840 and manufacturer's recommendations and in specific locations approved by Architect for visual effect.

E. Install metal reveals and trim in locations indicated. Coordinate with adjacent contrasting finish materials.

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.

B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.

C. Apply joint tape over gypsum board joints, except those with trim accessories having flanges not requiring tape.

D. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.

1. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
2. Level 5 for all exposed gypsum board surfaces.
3. Heavy “Knock-down” texture on ceilings

E. Use one of the following joint compound combinations as applicable to the finish levels specified:

1. Embedding and First Coat: Setting-type joint compound. Fill (Second) Coat: Setting-type joint compound. Finish (Third) Coat: Sandable, setting-type joint compound.

F. For Level 4 gypsum board finish, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.

G. Where Level 1 gypsum board finish is indicated, embed tape in joint compound.

3.10 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture **matching approved mockup and** free of starved spots or other evidence of thin application or of application patterns.

C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.11 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Architect will conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

1. Notify Architect one week in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.

2. Prior to notifying Architect, complete the following in areas to receive gypsum board ceilings:

   a. Installation of 80 percent of lighting fixtures, powered for operation.
   b. Installation, insulation, and leak and pressure testing of water piping systems.
   c. Installation of air duct systems.
   d. Installation of air devices.
   e. Installation of mechanical system control air tubing.
   f. Installation of ceiling support framing.

3.12 CLEANING AND PROTECTION

A. Promptly remove any residual joint compound from adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 092115

SECTION 092117 - GYPSUM BOARD SHAFT-WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Shaft enclosures including gypsum board and related framing

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for IEQ Credits 4.1, MR Credits 4 and 5.

2. Division 9 "**Gypsum Board Assemblies**" for applying and finishing panels in gypsum board shaft-wall assemblies.

1.3 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board construction not defined in this Section or in other referenced standards.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance:

1. Provide gypsum board shaft-wall assemblies capable of withstanding **the full** air-pressure loads indicated for maximum heights of partitions without failing and while maintaining an airtight and smoke-tight seal. Evidence of failure includes deflections exceeding limits indicated, bending stresses causing studs to break or to distort, and end-reaction shear causing track (runners) to bend or to shear and studs to become crippled.
2. Provide gypsum board shaft-wall assemblies for horizontal duct enclosures capable of spanning distances indicated within deflection limits indicated.

1.5 SUBMITTALS

A. Product Data: For each gypsum board shaft-wall assembly indicated.

B. LEED Submittal:

1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Fire-Test-Response Reports: From a qualified independent testing and inspecting agency substantiating each gypsum board shaft-wall assembly's required fire-resistance rating.

1. Include data substantiating that elevator entrances and other items that penetrate each gypsum board shaft-wall assembly do not negate fire-resistance rating.

D. Research/Evaluation Reports: Evidence of compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction that substantiate required fire-resistance rating for each gypsum board shaft-wall assembly.

E. Acoustical-Test-Response Reports: From a qualified independent testing agency substantiating required STC rating for each gypsum board shaft-wall assembly.

1.6 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from **UL's "Fire Resistance Directory."**

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat on leveled supports off the ground to prevent sagging.

1.8 PROJECT CONDITIONS

A. Comply with requirements for environmental conditions, room temperatures, and ventilation specified in Division 9 Section "**Gypsum Board Assemblies**."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Gypsum Co.
2. G-P Gypsum Corp.
3. Certainteed
4. National Gypsum Company.
5. United States Gypsum Co.

2.2 ASSEMBLY MATERIALS

A. General: Provide materials and components complying with requirements of fire-resistance-rated assemblies indicated.

1. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.
2. Provide auxiliary materials complying with gypsum board shaft-wall assembly manufacturer's written recommendations.

B. Steel Framing: ASTM C 645.

1. Protective Coating: **ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized** coating.

C. Gypsum Liner Panels: Manufacturer's proprietary liner panels in 1-inch (25.4-mm) thickness and with moisture-resistant paper faces.

D. Gypsum Wallboard: ASTM C 36, type C or X core as required by fire-resistance-rated assembly indicated.

1. Edges: **Tapered**.

E. Accessories: Cornerbead, edge trim, and control joints of material and shapes specified in Division 9 Section "**Gypsum Board Assemblies**" that comply with gypsum board shaft-wall assembly manufacturer's written recommendations for application indicated.

F. Gypsum Wallboard Joint-Treatment Materials: ASTM C 475 and as specified in Division 9 Section "**Gypsum Board Assemblies**."

G. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

H. Track (Runner) Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Powder-Actuated Fasteners: Provide powder-actuated fasteners with capability to sustain, without failure, a load equal to **10** times that imposed by shaft-wall assemblies,

as determined by testing conducted by a qualified independent testing agency according to ASTM E 1190.

I. Acoustical Sealant: **As recommended by gypsum board shaft-wall assembly manufacturer for application indicated.**

J. Sound Attenuation Blankets: ASTM C 665 for Type I, unfaced mineral-fiber-blanket insulation produced by combining thermosetting resins with mineral fibers manufactured from slag or rock wool.

2.3 GYPSUM BOARD SHAFT WALL

A. Basis-of-Design Product: As indicated on Drawings by design designation of a qualified testing and inspecting agency.

B. **Sustained** Air-Pressure Loads: **5.0 lbf/sq. ft.**.

C. Deflection Limit: **L/240**.

D. Studs: Manufacturer's standard profile for repetitive members and corner and end members and for fire-resistance-rated assembly indicated.

1. Depth: **4 inches (101.6 mm)** unless otherwise shown.

2. Min. Base Metal Thickness: Manufacturer’s standard thickness that complies with the structural performance requirements for stud depth indicated, but not less than .396 (20 gauge)

E. Track (Runner): Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least **2 inches (51 mm)**, in depth matching studs.

F. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches (76.2 mm), in depth matching studs, and not less than **0.0341 inch (0.87 mm)** thick.

G. Room-Side Finish: **Gypsum board,**.

H. Shaft-Side Finish: **As indicated by fire-resistance-rated assembly design designation**.

I. STC Rating**: 52**.

J. Cavity Insulation: Sound attenuation blankets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft-wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:

1. ASTM C 754 for installing steel framing.
2. Division 9 Section "**Gypsum Board Assemblies**" for applying and finishing panels.

B. Do not bridge building expansion joints with shaft-wall assemblies; frame both sides of joints with furring and other support.

C. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.

D. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

E. Isolate gypsum finish panels from building structure to prevent cracking of finish panels while maintaining continuity of fire-rated construction.

F. Install control joints to maintain fire-resistance rating of assemblies.

G. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with manufacturer's written instructions or ASTM C 919, whichever is more stringent.

END OF SECTION 092117

SECTION 092713 - GLASS-REINFORCED GYPSUM FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Factory-molded, glass-reinforced gypsum fabrications for interior use include the following types:

a. Column covers with minimum wall thickness of 3/8 inch.

2. Steel framing for direct support of glass-reinforced gypsum fabrications.

1.3 SUBMITTALS

A. Product Data: For each type of glass-reinforced gypsum fabrication indicated. Include construction details, material descriptions, weights, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show profiles, thicknesses, finishes, joints, ornamentation, installation tolerances, and anchorage details. Indicate attachment methods, embedded supports, reinforcement, fabrication methods, joint treatments, clearances, and supports.

C. Samples: For each exposed product in each profile and size required, and as follows:

1. Linear Components: 2-foot- (0.6-m-) long section with finished joint.

D. Installer Qualification Data: To demonstrate capabilities and experience of Installer. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, indicating current glass-reinforced gypsum fabrications comply with ASTM C 1355/C 1355M requirements.

G. Calculations prepared by a Utah Licensed Professional Engineer responsible for or having direct supervision over the production of calculations, and any other item or issue pertinent to the columns and ceiling systems design.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glass-reinforced gypsum fabrication installations similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

C. Fire-Test-Response Characteristics: Provide glass-reinforced gypsum fabrications with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another independent testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame Spread: 25 or less.
2. Smoke Developed: 450 or less.

D. Mockups: Before installing glass-reinforced gypsum fabrications, build mockups for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting glass-reinforced gypsum fabrication.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed.
7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Ship and store glass-reinforced gypsum fabrications in factory-wrapped crates, packaged to keep units dry. Avoid cracking, warping, or staining the units.

B. Comply with manufacturer's written instructions for storage, temperature, and humidity requirements.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install glass-reinforced gypsum fabrications until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Acclimatize glass-reinforced gypsum fabrications to ambient temperature and humidity of spaces in which they will be installed. Remove packaging and move units into installation spaces not less than 48 hours before installing them.

C. Field Measurements: Where glass-reinforced gypsum fabrications are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

A. Coordinate layout and installation of glass-reinforced gypsum fabrications and suspension system components with other construction, including ceilings, light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Architectural Reproductions Inc.
2. Formglas Inc.
3. Molded Fiber Glass/Union City.
4. Plastrglas.
5. WCI, Inc.

2.2 STEEL FRAMING COMPONENTS

A. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190 conducted by a qualified independent testing agency.

B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch- (5-mm-) wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:

1. Thickness: 0.0396 inch, unless otherwise indicated.
2. Depth: 2-1/2 inches (64 mm), unless otherwise indicated.
3. Protective Coating: ASTM A 653, G40 (ASTM A 653M, Z90) hot-dip galvanized coating.

C. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing members securely to substrates.

2.3 GLASS-REINFORCED GYPSUM FABRICATION MATERIALS

A. Glass-Reinforced Gypsum Fabrications: ASTM C 1355/C 1355M.

B. Embedments: As standard with glass-reinforced gypsum fabrication manufacturer and as required for reinforcement and for anchorage to substrates and framing.

2.4 PHYSICAL PROPERTIES - GFRG

Shell Thickness		3/8”
Weight (depending on reinforcing)		1-1/2 – 2 lbs/sq.ft
Density		103 - 112 lbs/cu.ft
Flexural Strength (ASTM C-947-89 MOD.)		4,820 psi
Compressive Strength (ASTM C-472-90 MOD.)		13,800 psi
Modulus of Elasticity – In flexure (ASTM C-947-89 MOD.)		3.38 x 10/6 psi
Tensile Strength (ASTM D-638-94 b MOD.)		1,810 psi
Impact Strength (ASTM D-256-93a)		3.26 ft.lb/in of notch
Hardness (ASTM D-2583-93)		54
Fiber Content		5 – 6% by weight
Coefficient of Expansion (ASTM D-696-91)		1.76 x 10-5 in./in./°F
Fuel Contribution (ASTM E84-80)		0
Flame Spread (ASTM E-136-94a)		0
Smoke Index (ASTM E84-80)		0
Fastener Withdrawal	- with wood embedded	329 lbs
	- with steel embed	764 lbs

2.5 AUXILIARY MATERIALS

A. Adhesives: As recommended in manufacturer's written instructions.

B. Steel Drill Screws: Provide fasteners, complying with the following requirements, that are of sufficient length and size to securely fasten gypsum-reinforced fabrications to framing members:

1. Screws complying with ASTM C 1002 for fastening glass-reinforced gypsum fabrications to steel members less than 0.033 inch (0.84 mm) thick.
2. Screws complying with ASTM C 954 for fastening glass-reinforced gypsum fabrications to steel members.

C. Joint Treatment Materials: Provide materials complying with ASTM C 475 and with the recommendations of the manufacturers of both glass-reinforced gypsum fabrications and joint treatment materials for each application indicated.

2.6 FABRICATION

A. Fabricate glass-reinforced gypsum units from molds constructed of rigid materials that will result in smooth-finished surfaces conforming to profiles, dimensions, and tolerances indicated. Provide units as large as practical to minimize joints.

B. Remove units from molds and repair hollows, voids, scratches, and other surface imperfections.

C. Material Compatibility: Fabricate glass-reinforced gypsum fabrications with surface characteristics required for a high-gloss paint finish.

D. Embedments: Incorporate embedments so they develop the full strength of glass-reinforced gypsum fabrications. Cover embedments with glass-reinforced gypsum composite not less than 3/16 inch (5 mm) thick.

E. Connection Hardware: Custom designed and fabricated to support and connect glass-reinforced gypsum fabrications to hangers, support framing, and substrates.

F. Dimensional Tolerances of Units: As follows:

1. Factory-Finished Edge Straightness: Plus or minus 1/8 inch (3.2 mm).
2. Plane Surface Straightness: Plus or minus 1/8 inch (3.2 mm).
3. Overall Assembled Length and Width: Plus or minus 1/8 inch (3.2 mm) per 10 feet (3 m).
4. Chords, Radii, and Diameters: Plus or minus 1/8 inch (3.2 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for environmental conditions, installation tolerances, and other conditions affecting performance of glass-reinforced gypsum fabrications.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 STEEL FRAMING INSTALLATION

A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with details indicated. Select framing components of type, size, and spacing needed to support weight of glass-reinforced gypsum fabrications and to maintain erection tolerances.

B. Supplementary Framing, Blocking, and Bracing: Install supplementary framing as required not only to support glass-reinforced gypsum fabrications but also fixtures and other items penetrating glass-reinforced gypsum fabrications.

3.3 GLASS-REINFORCED GYPSUM FABRICATION INSTALLATION

A. Install glass-reinforced gypsum fabrications level, plumb, true, and aligned with adjacent materials. Use concealed shims where required for alignment.

B. Predrill fastener holes in glass-reinforced gypsum fabrications. Clean fastener holes to remove dirt and oil.

C. Attach glass-reinforced gypsum fabrications to framing and substrates with steel drill screws. Do not use pneumatic staple guns. Countersink screw heads below adjoining finished surface.

D. Fasten as required to comply with dimensional tolerances and not less than 5/16 inch (7.9 mm) from edge to end.

E. Cover screw heads with joint compound to produce flush, smooth, and level finished surfaces.

F. Attach glass-reinforced gypsum fabrications at joints with adhesive, and band or brace together until adhesive is cured. Cure adhesive according to glass-reinforced gypsum fabrication manufacturer's written instructions.

G. Joint Finishing: Comply with ASTM C 840 for the following finish level:
   1. Level 5.

3.4 ERECTION AND LOCATION TOLERANCES

A. Erection Tolerances: Install glass-reinforced gypsum fabrications so each unit complies with the following dimensional requirements:

   1. Plane Alignment (Panel to Panel): 1/16 inch (1.6 mm).
   2. Variation from Plumb: Plus or minus 1/8 inch (3.2 mm) per 10 feet (3 m).
   3. Assembly Deflection: Not greater than the length of the assembly divided by 240.
   4. Joint Alignment: Not more than 1/16 inch (1.6 mm).

END OF SECTION 092713

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Ceramic porcelain tile. thin-set . Colors as shown
2. Glazed wall tile. – with accent as shown.
3. Stone thresholds installed as part of tile installations.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.

1.3 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).

1.4 SUBMITTALS

A. Product Data: For each type of tile, mortar, grout, and other products specified.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

2. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

3. Product Certificates for Credit MR 5.1 and **5.2**: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Tile Samples for Initial Selection: Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.

D. Grout Samples for Initial Selection: Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

E. Samples for Verification: Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.

1. Each type and composition of tile and for each color and texture required, at least 12 inches (300 mm) square, mounted on braced cementitious backer units, and with grouted joints using product complying with specified requirements and approved for completed work in color or colors selected by Architect.
2. Full-size units of each type of trim and accessory for each color required.
3. Stone thresholds in 6-inch (150-mm) lengths.

F. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

G. Product Certificates: Signed by manufacturers certifying that the products furnished comply with requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

D. Source Limitations for Stone Thresholds: Obtain stone thresholds from one source and by a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.8 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 2 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following and as scheduled on the Drawings:

1. Tile Products:
   a. As indicated

2. Tile-Setting and -Grouting Materials:

   a. American Olean Tile Company.
   b. C-Cure Corporation.
   c. Dal-Tile Corporation.
   d. Mapei Corporation.
   e. TEC Incorporated.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and

other appearance characteristics, provide specific products or materials complying with the following requirements:

1. Provide Architect's selections matching colors and patterns scheduled.

D. Factory Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

E. Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.

2.3 TILE PRODUCTS

A. Unglazed Porcelain Mosaic Tile for floors: Provide factory-mounted flat tile complying with the following requirements:

1. Composition: Porcelain.
2. Module Size: 2 by 2 inches
3. Nominal Thickness: 3/8 inch (6.35 mm).
4. Face: Plain with cushion edges.
5. Field color with 2 accent colors, with cove base piece
6. Price Groups: 1,2

B. Glazed Wall Tile: Provide flat tile complying with the following requirements:

1. Module Size: 4 x 4 inches in Toilets 3 by 6 inches in Kitchen
2. Thickness: 5/16 inch (8 mm).
3. Face: Plain with modified square edges or cushion edges.
4. Price Groups: 1,2

C. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with the following requirements:

1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
2. Shapes: As follows, selected from manufacturer's standard shapes:

   a. Base for Cement Mortar Installations: Built up base Dal-Tile MB-5A.
   b. External Corners for Cement Mortar Installations: Bullnose with a minimum ¾ inch radius. Dal-Tile S-832 or equal
   c Wainscot Cap: Bullnose cap.
   d. Internal Corners: Field-butted square corners, except with coved base and cap angle pieces designed to member with stretcher shapes.

2.4 STONE THRESHOLDS

A. General: Provide stone thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces.

1. Fabricate thresholds to heights indicated, but not more than 1/2 inch (12.7 mm) above adjoining finished floor surfaces, with transition edges beveled on a slope of no greater than 1:2.

B. Stone Thresholds: Provide thresholds complying with ASTM C 503 requirements for exterior use and with a minimum abrasive-hardness value of 10 per ASTM C 241.

1. Match Architect's sample for color and finish.

2.5 WATERPROOFING MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10.

B. Composite Membrane: Combination of fabric and rubberized asphalty, 40 miles thick, wound on core, for adhering to latex-portland cement mortar; 75 inches wide.

1. Available Product: Polyguard Products tile Guard

Mapei Custom

C. For use as a crack isolation membrane

2.6 SETTING MATERIALS

A. Latex-Portland Cement Mortar: ANSI A118.4, composed as follows:

1. Mixture of Dry-Mortar Mix and Latex Additive: Mixture of prepackaged dry-mortar mix and liquid-latex additive complying with the following requirements:

a. Latex Additive: Acrylic resin.
b. For wall applications, provide nonsagging, latex-portland cement mortar complying with ANSI A118.4 for mortar of this type defined in Section F-2.1.2.

2.7 GROUT MATERIALS

A. Sand Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Polymer-Modified Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

a. Boiardi Products; a QEP company.
b. Bonsal American; an Oldcastle company.
c. Bostik, Inc.
d. C-Cure.
e. Custom Building Products.

f. Jamo Inc.
g. Laticrete International, Inc.
h. MAPEI Corporation.
i. Southern Grouts & Mortars, Inc.
j. Summitville Tiles, Inc.
k. TEC; a subsidiary of H. B. Fuller Company.

2. Polymer Type: **Acrylic resin or styrene-butadiene rubber** in liquid-latex form for addition to prepackaged dry-grout mix.

2.8 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements of Division 7 Section "Joint Sealants."

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes.

1. Use sealants that have a VOC content of **250** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Products: Subject to compliance with requirements, provide one of the following:

1. One-Part, Mildew-Resistant Silicone Sealants:

a. Dow Corning 786; Dow Corning Corporation.
b. Sanitary 1700; GE Silicones.
c. Pecora 898 Sanitary Silicone Sealant; Pecora Corp.
d. Rhodorsil 6B White; Rhone-Poulenc, Inc.
e. Tremsil 600 White; Tremco, Inc.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

C. Temporary Protective Coating: **Either product** indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar,

and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

D. Grout Sealer: Manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

Available Products:

a. Bonsal, W. R., Company; Grout Sealer.
b. Bostik; CeramaSeal Grout Sealer.
c. C-Cure; Penetrating Sealer 978.
d. Custom Building Products; **Grout and Tile** Sealer.
e. MAPEI Corporation; KER **004, Keraseal Penetrating Sealer for Unglazed Grout and Tile**.
f. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
g. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.

2.10 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

B. Provide concrete substrates for tile floors that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.

1. Use trowelable leveling and patching compounds per tile-setting material manufacturer's written instructions to fill cracks, holes, and depressions.
2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCNA Installation Guidelines: TCNA's "Handbook for Ceramic Tile Installation." Comply with TCNA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in patterns as indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.
2. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."

G. Grout tile to comply with the requirements of the following tile installation standards:

1. For ceramic tile grouts (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts), comply with ANSI A108.10.

3.4 WATERPROOFING MEMBRANE INSTALLATION

A. Install waterproofing and crack suppression membrane to comply with ANSI A108.13 and waterproofing manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.

3.5 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing TCA installation methods and ANSI A108 series of tile installation standards.

B. Joint Widths: Install tile on floors with the following joint widths:

1. Ceramic porcelain Tile: 1/16 inch (1.6 mm).

C. Back Buttering: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:

D. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.

1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.

3.6 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Joint Widths: Install tile on walls with the following joint widths:

1. Wall Tile: 1/16 inch (1.6 mm).

3.7 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.

1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.

D.. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.8 CERAMIC TILE FLOOR INSTALLATION SCHEDULE

A. Ceramic Tile Floor Installation – Toilet rooms, Kitchen

1. Tile Type: Unglazed ceramic mosaic and porcelain tile on waterproof membrane
2. Installation Method –TCNA F122- 09
3. Setting Bed and Grout: ANSI A108.5 with the following mortar and grout:

   a. Latex-portland cement mortar.
   b. Unsanded latex-portland cement grout.

3.9 CERAMIC TILE WALL INSTALLATION SCHEDULE

A. Ceramic Tile Wall Installation

1. TCNA W241-09 (cement mortar bed bonded to backer units).
2. Setting Bed and Grout: ANSI A108.1B with the following mortar and grout:
   a. Latex-portland cement mortar.
   b. Unsanded latex-portland cement grout.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

1. This Section includes ceilings consisting of acoustical panels and exposed suspension systems – heavy duty to comply with IBC requirements.

1.3 SUBMITTALS

1. Product Data: For each type of product specified.

2. LEED Submittals:

    1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

        a. Include statement indicating costs for each product having recycled content.

    2. Product Data for Credit IEQ 4.1: For sealants, including printed statement of VOC content.

3. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

    1. Ceiling suspension system members.
    2. Method of attaching suspension system hangers to building structure.
    3. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
    4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

4. Samples for Initial Selection: Manufacturer's color charts consisting of actual acoustical panels or sections of acoustical panels, suspension systems, and moldings showing the full range of colors, textures, and patterns available for each type of ceiling assembly indicated.

5. Samples for Verification: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.

    1. 6-inch- (150-mm-) square samples of each acoustical panel type, pattern, and color.
    2. Set of 12-inch- (300-mm-) long samples of exposed suspension system members, including moldings, for each color and system type required.

6. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

7. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.

8. Research/Evaluation Reports: Evidence of acoustical panel ceiling's and components' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

1. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

2. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

3. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

    1. Obtain both acoustical ceiling panels and suspension system from the same manufacturer.

4. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

    1. Fire-response tests were performed by UL, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
    2. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
    3. Fire-resistance-rated assemblies, which are indicated by design designations from UL's "Fire Resistance Directory," from ITS/Warnock Hersey's "Directory of Listed Products," or from the listings of another testing and inspecting agency, are identical in materials and construction to those tested per ASTM E 119.
    4. Products are identified with appropriate markings of applicable testing and inspecting agency.

5. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.5 DELIVERY, STORAGE, AND HANDLING

1. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

2. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

3. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

1. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

1. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA MATERIALS

1. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

    1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent but not less than 4 panels minimum of amount installed for each panel type.
    2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated for each designation in the Acoustical Panel Ceiling Schedule at the end of Part 3.

2.2 ACOUSTICAL PANELS, GENERAL

1. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance’s, unless otherwise indicated.

1. Mounting Method for Measuring Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.

2. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

    1. Where appearance characteristics of acoustical panels are indicated by referencing ASTM E 1264 pattern designations and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range of products that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

3. Panel Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3, including those referencing ASTM E 1264 classifications.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

1. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, heavy duty structural classification, and finishes indicated that comply with applicable ASTM C 635 requirements.

2. Metal Suspension System Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3.

3. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

4. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.

5. Wire Hangers, Braces, and Ties: Provide wires at Contractor’s option complying with the following requirements:

    1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
    2. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
    3. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

6. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.

    1. For circular penetrations of ceiling or bullnose corners, provide edge moldings fabricated to diameter required to fit penetration exactly. Exposed Face will not be stepped but shall match adjacent flat moldings. Flexible moldings may be used at bullnose corners.

    2. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Comply with paint manufacturer's written instructions for applying and baking and for minimum dry film thickness.

a. Organic Coating: Manufacturer's standard thermosetting coating system with a minimum dry film thickness of 0.8 to 1.2 mils (0.02 to 0.03 mm).
b. Color: Match color of finish on flanges of suspension system surfaces.

3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong World Industries, Inc.
b. Celotex Corporation (The); Building Products Division; Architectural Ceilings Marketing Dept.
c. Chicago Metallic Corporation.
d. Fry Reglet Corporation.
e. Gordon, Inc.
f. MM Systems, Inc.
g. USG Interiors, Inc.

7. Seismic Bracing, Spreader Bars and Expansion Joints: As required by IBC 2009.
1. If required, expansion joints to be designed and located as approved
2. Seismic Retention Clips if approved by code official to be located as approved

2.4 METAL EDGE MOLDINGS AND TRIM

1. Basis-of-Design Product: Subject to compliance with requirements, provide **the product indicated on Drawings** or a comparable product

2. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
2. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
3. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; organic coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

a. Organic Coating: Thermosetting, primer/topcoat system with a minimum dry film thickness of 0.8 to 1.2 mils (0.02 to 0.03 mm).

2.5 ACOUSTICAL SEALANT

1. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:

1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant**, with a VOC content of 250 g/L or less,** recommended for sealing interior concealed joints to reduce airborne sound transmission.

3. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

    1. Acoustical Sealant for Exposed and Concealed Joints:

        a. PL Acoustical Sealant; Chemrex, Inc., Contech Brands.
        b. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
        c. SHEETROCK Acoustical Sealant; United States Gypsum Co.

PART 3 - EXECUTION

3.1 EXAMINATION

1. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.

    1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

1. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

1. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
    1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
    2. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4, IBC Seismic Zone D.

2. Suspend ceiling hangers from building's structural members and as follows:

    1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
    2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
    3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches (200 mm) from ends of each member.

3. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

4. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

    1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
    2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m). Miter corners accurately and connect securely.
    3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

5. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

6. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

    1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
    2. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
    3. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

1. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.5 ACOUSTICAL PANEL CEILING SCHEDULE

1. General Areas, Water-felted, mineral-base acoustical panels. Provide non-fire rated and fire-resistance-rated if indicated. Comply with the following:

    1. Products: Provide one of the following:
        a. Cortega, Armstrong Industries.
        b. Hytone Baroque; Celotex Corp.
        c. Radar; USG Interiors, Inc.

    2. Classification: Panels fitting ASTM E 1264 for Type III, mineral base with painted finish; Form 2, water felted.
    3. Pattern: Panels fitting ASTM E 1264 pattern designation CD (perforated, small holes and fissured).
    4. Color: White.
    5. Light Reflectance Coefficient: Not less than LR 0.80.
    6. Noise Reduction Coefficient: NRC 0.55.
    7. Edge Detail: Square.
    8. Thickness: 5/8 inch (16 mm).
    9. Size: 24 by 24 inches (610 by 1220 mm). and 24 x 48 inches

B. Ceiling Accent Panels in Corridors

    1. Design Standard: USG Interiors, Inc.; Mars ClimaPlus.

    2. Classification: Panels fitting ASTM E 1264 for Type IV, mineral base; Form 1 or 2 (Nodular or Water-Felted), Pattern E, G(Lightly Textured).
    3. Color: White.
    4. Light Reflectance Coefficient: Not less than LR 0.89.
    5. Noise Reduction Coefficient: NRC 0.70.
    6. Edge Detail: Square
    7. Thickness: 3/4 inch.
    8. Size: 24 by 48 inches. Cut to 8 by 48 inches or custom manufactured to size

C. Water-felted, mineral-base acoustical panels with membrane-faced overlay for acoustical panel ceiling - **Kitchen Area**
    1. Products: Provide one of the following:
        a. Armstrong Clean Room VL Type IV Form 2
        b. USG Clima Plus type III form 2

    2. Classification: Provide panels complying with ASTM E 1264 as noted, mineral base with membrane-faced overlay; Form 2, water felted.
        a. Overlay: Vinyl overlay on face.
    3. Pattern: E (lightly textured) or G (smooth).
    4. Color: **White**.
    5. LR: Not less than **0.75**.

6. CAC: Not less than **45**.
7. Edge Detail: **Square**.
8. Thickness: ½ or **5/8 inch (15 mm)** as standard with manufacturer.
9. Size: **24 by 48 inches (610 by 1220 mm)**.

D. Suspension System for Acoustical Panel Ceiling: Provide acoustical panel ceiling suspension system complying with the following:

1. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, G01 (Z001) coating designation, with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges; other characteristics as follows:

   a. Structural Classification Heavy-duty system
   b. End Condition of Cross Runners: Override (stepped) or butt-edge type, as standard with manufacturer.
   c. Face Design: Flush face.
   d. Cap Material: Steel sheet for general areas.
   e. Cap Finish: Painted white.
   f. Mounting method: With compression struts as indicated for seismic loading.
   g. Edge moldings: Hemmed Edge 2 inch edge angle per IBC 2009 requirements or combined with 1 inch edge angle and Armstrong BERC Clips or Chicago Metallic Seismic Retention Clip concealed in framing members if acceptable to Building Authority.

END OF SECTION 095113

SECTION 095134 - ACOUSTICAL METAL PAN CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes **snap-in** acoustical curved metal pans and the following suspension system for ceilings:

1. Direct hung, with setback hangers and concealed suspension.

B. Related Sections:
1. Division 9 Section "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and acoustical panels and exposed suspension systems.
2. Divisions 13, 23 and 26 Sections for light fixtures, sprinklers, and air-distribution components.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Exterior snap-in metal pan ceilings shall withstand exterior exposure and the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of ceiling units; or permanent damage to fasteners and anchors.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): **100 deg F (55 deg C)**.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

2. Product Data for Credit IEQ 4.1: For sealants, including printed statement of VOC content.

C. Samples for Initial Selection: For components with factory-applied color and other decorative finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:

1. Metal Pans: Set of **full-size** Samples of each type, finish, color, pattern, and texture. Show pan edge profile.
2. Exposed Suspension System Members, Moldings and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
3. Sound Absorber: Match size of Sample metal pan.

E. Performance Data: For installed products indicated to comply with design loads and other criteria, include structural analysis and other analytical data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension members.
2. Method of attaching hangers to building structure.

   a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
4. Ceiling perimeter and penetrations through the ceiling; and trim and moldings.
5. Minimum Drawing Scale: **1/8 inch = 1 foot (1:96)**.

G. Qualification Data: For testing agency.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical metal pan ceiling.

I. Field quality-control reports.

J. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

B. Source Limitations:

1. Acoustical Ceiling Pans: Obtain each type from single source from single manufacturer.
2. Suspension Systems: Obtain each type from single source from single manufacturer.

C. Source Limitations for Acoustical Metal Pan Ceilings: Obtain each combination of acoustical metal pans and exposed suspension systems from one source with resources to provide products of consistent quality in appearance, physical properties, and performance.

D. Surface-Burning Characteristics: Complying with ASTM E 1264 for **Class A** materials as determined by testing identical products according to ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

E. Seismic Standard: Provide acoustical metal pan ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
2. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies - Seismic Zones 3 & 4."

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at **Project site**.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical metal pans, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Handle acoustical metal pans, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical metal pan ceilings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Metal Pans: Full-size units not less than 6 standard panels.

2. Suspension System Components: Quantity of each grid and exposed molding and trim 16 lineal feet

PART 2 - PRODUCTS

2.1 ACOUSTICAL METAL CEILING PANS

A. Acoustical Metal Pan Standard: Provide manufacturer's standard acoustical metal pans of configuration indicated that comply with ASTM E 1264 classifications as designated by types, acoustical ratings, and light reflectances unless otherwise indicated.

B. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.

1. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C 635.

a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A 591/A 591M, 40Z (12G) coating, surface treatment as recommended by finish manufacturer for type of use and finish indicated.

b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A 1008/A 1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.

C. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84.

1. Bond fabric layer to panels in the factory with manufacturer's standard nonflammable adhesive.

2.2 STEEL PANS FOR ACOUSTICAL METAL PAN CEILING - CURVED

A. Available Manufacturers include the following:

Armstrong World industries

Ceilings Plus

Hunter Douglas

B. Design Standard: Armstrong World Industries, Inc. Metalworks

C. Ceiling Panels

1. Surface Texture: Smooth - Perforated small diameter pattern.

2. Composition: Metal

3. Color: as selected from manufacturers standards

4. Size: 24in X 24in , 48in. 72in. and 96 inches

5. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton, 0.65.

6. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton, 31

7. Flame Spread: ASTM E 1264; Class A (FM)

8. Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance: 0.77.

D. Pan Edge Detail: **Square**.

E. Pan Joint Detail: **Narrow reveal, not greater than 9/16 inch (15 mm) wide**

F. Pan Face Finish: **Painted in color selected from manufacturer's full range**

2.3 METAL SUSPENSION SYSTEMS

A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Suspension Systems: Provide systems complete with carriers, runners, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, and other suspension components required to support ceiling units and other ceiling-supported construction.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to **five** times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
   a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
   b. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
   c. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to **10** times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

E. **Hanger Rods where exposed** Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical metal pans in place.

I. Exposed Metal Edge Moldings and Trim: Provide exposed members as indicated or as required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of and penetrations through ceiling, to conceal edges of pans and runners, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching acoustical metal pan ceiling units, unless otherwise indicated.

2.4 DIRECT-HUNG, STANDARD-GRID, METAL SUSPENSION SYSTEM FOR ACOUSTICAL METAL PAN CEILING

A. Suspension System: For **clip-in** pans.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Serpentina or a comparable product 2 ¼ inch side profile

B. System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized according to ASTM A 653/A 653M, G30 (Z90) coating designation, with prefinished, cold-rolled, 15/16-inch- (24-mm-) wide sheet metal caps on flanges.

1. Structural Classification: **Heavy**-duty system.
2. End Condition of Cross Runners: **Butt-edge** type.
3. Face Design: Flat, flush.
4. Cap Material: **Steel** cold-rolled sheet.
5. Cap Finish: **Painted in color as selected from manufacturer's full range**

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 GALVANIZED-STEEL SHEET FINISHES

A. Color-Coated Finish: Manufacturer's standard[**powder-coat**] baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

2.7 STEEL SHEET FINISHES

A. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical metal pan ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical metal pan ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width pans at borders, and comply with layout shown on reflected ceiling plans and Coordination Drawings.

3.3 INSTALLATION

A. Install acoustical metal pan ceilings to comply with **ASTM C 636** and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Locate hangers away from corner/edge of panels for clean appearance.
3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved.
7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
9. Do not attach hangers to steel deck tabs.
10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
11. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pans.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Cut acoustical metal pan units for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.

G. Install acoustical metal pans in coordination with suspension system and exposed moldings and trim.

1. For lay-in square-edge pans, install pans with edges fully hidden from view by flanges of suspension system runners and moldings.
2. For lay-in reveal-edge pans on suspension system members with box-shaped flanges, install pans with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.

3. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
4. Fit adjoining units to form flush, tight joints.
5. Install sound-absorbent fabric layers in perforated metal pans.

3.4 CLEANING

A. Clean exposed surfaces of acoustical metal pan ceilings, including trim and edge moldings after removing strippable, temporary protective covering, if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION 095134

SECTION 096511 - RESILIENT TERRAZZO TILE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Terrazzo Tile in both low density and high density patterns

B. Accessories.

1.2 RELATED SECTIONS

A. Section 033000 - Cast-in-Place Concrete.

B. Section 079100 - Joint Sealers.

C. Section 096113 – Resilient Accessories for resilient accessories in other areas of the work.

1.3 REFERENCES

A. ASTM C 109/C 109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens); 1999.

B. ASTM D 695 - Standard Test Method for Compressive Properties of Rigid Plastics; 1996.

C. ASTM D 2047 - Standard Test Method for Static Coefficient of Polish-Coated Floor Surfaces as Measured by the James Machine; 1999.

D. ASTM D 2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2000.

E. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2000a.

F. ASTM E 648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2000.

G. ASTM E 662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials; 1997.

H. ASTM F 510 - Standard Test Method for Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with a Grit Feed Method; 1993.

I. ASTM F 540 - Standard Test Method for Squareness of Resilient Floor Tile by Dial Gage Method; 1998.

J. ASTM F 925 - Standard Test Method for Resistance to Chemicals of Resilient Sheet Flooring; 1997.

K. ASTM F 970 - Standard Test Method for Static Load Limit; 2000.

L. ASTM F 1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 1998.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements of Terrazzo Tiles:
1. Abrasion Resistance: Maximum 0.0196 cubic centimeters volume loss, when tested in accordance with ASTM F 510, Taber abrader, S-39 wheels, at 500 cycles with 1000 gram load.
2. Compressive Strength: Between 2900 and 5000 psi (20 and 34.5 MPa), when tested in accordance with ASTM C 109/C 109M or ASTM D 695.
3. Static Load Limit: 0.0007 inch (0.012 mm) maximum indentation, when tested in accordance with ASTM F 970 at 125 pounds (57 kg).
4. Hardness: When tested in accordance with ASTM D 2240:
   a. Matrix: Shore D 78, minimum.
   b. Aggregate: Between Barcol 55 and 100.
5. Coefficient of Friction: Greater than 0.7, average 0.74, when tested in accordance with ASTM D 2047.
6. Flame Spread Index: 15, maximum, when tested in accordance with ASTM E 84.
7. Smoke Density: Specific optical density, when tested in accordance with ASTM E 662, of 231.76 (smoldering) and 292.05 (flaming).
8. Critical Radiant Flux: Minimum of 0.93 watt/cubic centimeter (Class 1) when tested in accordance with ASTM E 648.
9. Chemical Resistance: No change or surface attack, color change, or swelling, when tested in accordance with ASTM F 925.
10. Oil Resistance: Complying with MIL D-3134.
11. Corrosion Resistance: Complying with MIL D-3134.
12. Electrical Conductance: Nonconductive.
13. Squareness: 0.003 inch (0.076 mm) out of square, maximum, when measured in accordance with ASTM F 540.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and technical data for precast terrazzo tile and accessories; including manufacturer's printed installation instructions and maintenance manuals for each material specified.

B. LEED Submittals

1. Product Data for Credit IEQ 4.1: For adhesives sealants and chemical-bonding compounds, including printed statement of VOC content. Sealant VOC not to exceed 250 g/l. Adhesive VOC not to exceed 80 g/l.

C. Samples for Selection: Submit manufacturer's samples of actual sections of tile and accessories; include manufacturer's full range of color and patterns available.

D. Samples for Verification Prior to Installation: Submit full size samples of all types, colors, and patterns selected, indicating full range of patterning and color variations.

E. Test Reports: Submit test reports for bond and moisture tests of substrates.

F. Certificates: Submit certificates from manufacturer stating compliance with applicable requirements for materials specified.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm who has at least three years of experience with the installation of precast terrazzo tile and has successfully completed installations of a similar size and scope.

B. Regulatory Requirements: Comply with requirements of local building code and applicable regulations of other government authorities.

C. Mock-ups: Approved samples constitute standard for installer to achieve.

D. Pre-Installation Meeting: Meet with tile manufacturer's representative and Owner prior to preparation of substrate and installation of tile, to review manufacturer's instructions and requirements to ensure the tile is installed properly.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packages, containers or bundles bearing brand name and identification of manufacturer.

B. Store materials inside, under cover in a manner to keep them dry, protected from the weather, direct sunlight, surface contamination, corrosion, and damage from construction traffic and other causes.

1.8 PROJECT CONDITIONS

A. Maintain minimum temperature of 70 degrees F (21 degrees C) in spaces to receive precast terrazzo tile, for at least 48 hours before, during and after installation. Store materials in space where they will be installed for at least 48 hours or as required ensuring that the materials have reached 70 degrees F (21 degrees C) before staring installation.

B. Install terrazzo tile and accessories after other finishing operations, including painting, have been completed.

C. Do not install terrazzo tile on concrete slabs until they have been cured and are sufficiently dry to achieve bond with adhesives, as determined by the tile manufacturer's recommended bond and moisture test. Allow sufficient time for the slab to dry out before installation is started.

D. Provide adequate lighting to allow for proper installation.

E. Do not use portable or temporary heat.

1.9 WARRANTY

A. Submit 20-year wear warranty written material warranty from tile manufacturer warranting that tile is free from defects in workmanship and material.
   1. Products must be installed so as not to void the manufacturer's warranty for wear.
   2. Warranty shall be in form acceptable to Owner.

1.10 MAINTENANCE

A. Extra Materials: Furnish one box of tile for each fifty boxes or fraction thereof, for each type, color, pattern and size of the tile installed, from same manufactured lot as materials installed.
   1. Deliver extra tile to Owner after completion of work.

2. Furnish tiles in protective packaging with identifying labels.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers include, but are not limited to the following:

Fritz Industries, Inc; www.fritztile.com.

B. Other manufacturers may be considered that do not deviate from the design intent of the Contract Documents.

C. Obtain all materials including terrazzo tile and recommended adhesives and leveling compounds from a single manufacturer.

2.2 MATERIALS

A. Terrazzo Tile: Marble or granite chips embedded in flexible thermoset polyester resin matrix, with random distribution of chips and smooth factory applied urethane coating cured by ultra violet exposure process.
1. Color/Pattern/Thickness: as selected by Architect from manufacturer's full range of standard and premium grade products; thickness 3/16 inch.
2. Size: 12 by 12 inches (305 by 305 mm), nominal.
3. Obtain all tile materials intended to match from same production run.
4. Style RG-2000 Series
5. Recycled content 20% Post consumer recycled glass aggregate.

B. Wall Base: Coved Rubber with top-set toe. Reference other Division 9 Section.

C. Leveling Compound for Large Areas: Self-leveling polymer modified pozzolanic cementitious formula; Equal to Fritz F10 Fast Track, for use over concrete from a featheredge to 1-1/2 inches (38 mm).

D. Patching Compound for Small Areas Equal to the following products:
1. Fritz Poz 1, Fast Setting Underlayment, for use over concrete from a featheredge to 1-1/2 inches.
2. Fritz Poz 2, Rapid Setting Underlayment, for use from a featheredge to 1-1/2 inches (38 mm), requiring flexural properties.
3. Fritz Poz Patch 3, Skim Coating Patch, for use from a featheredge to 1/8 inch (3 mm) as a skim coat for minor depressions.

E. Floor Adhesive: Equal to Fritz FA88 Powdered Cementitious Multipurpose Adhesive, mixed with water, for installation using 1/8 by 1/8 by 1/8 inch (3 by 3 by 3 mm) U-notched trowel.

F. Wall Base Adhesive: Cove/Wall Adhesive, as recommended by manufacturer.

G. Sealer and Finish: Two coats of Fritz FCP-102 or equal protective sealer and two coats of Fritz Duro-Gloss Finish FCP-300 or equal, applied as recommended by manufacturer.

H. Sealant: Silicone, as specified in Section 07920, and of type approved by tile manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Concrete Subfloor:
   1. Inspect subfloor to verify that it is clean, flat, smooth, level and free from cracks, holes, ridges, coatings preventing adhesion, and other defects impairing performance or appearance.
   2. Notify Architect of conditions that would adversely affect flooring installation; do not proceed until defective conditions have been corrected.
   3. Perform bond and moisture tests on concrete subfloors to determine if surfaces are sufficiently cured and dry as well as to ascertain presence of curing, sealing, hardening or any other compounds.
      a. Perform bond test in accordance with tile manufacturer’s warranty requirements.
      b. Perform moisture test in accordance with ASTM F 1869.
      c. Do not install tile if moisture vapor transmission exceeds 7 pounds (3 kg) per 1000 square feet (93 sq m) in 24 hours using FA88 Adhesive.
      d. Submit test results and obtain Architect's acceptance prior to beginning installation.
   4. Do not proceed until substrate preparation is complete and satisfactory, bond and moisture tests are completed and test reports submitted which indicate that bond and moisture values meet specified requirements.

B. Coordinate work with that of other installers prior to installation so that tile work fits properly with doors, frames, saddles, floor drains, and other adjacent work.

C. Start of work constitutes acceptance that conditions are satisfactory.

D. Close the space and areas where flooring is being installed to traffic and other installers until flooring has set and sealing and finish of tiles are complete.

3.2 PREPARATION

A. Fill small cracks, holes and depressions in subfloors using leveling and patching compounds recommended by tile manufacturer.

B. Remove deleterious coatings from subfloor surfaces that would prevent a positive adhesive bond; such as curing compounds incompatible with adhesives, paints, oils, adhesives, waxes and sealers.

C. Completely remove existing solvent-based adhesives to prevent bleed through and staining.

D. Remove existing floor covering and condition subfloor to provide smooth, clean continuous surface; level subfloor with self-leveling compound in compliance with tile manufacturer’s specifications and installation instructions.

3.3 INSTALLATION

A. Comply with manufacturer’s instructions for terrazzo tile installation.

B. Scribe, cut and fit tile to permanent fixtures, built-in furniture, cabinets, pipes, outlets and permanent columns, wall, and partitions using tile cutting procedures recommended by tile manufacturer.

C. Maintain reference markers indicated on subfloor for future cutting, by repeating on finished terrazzo tile floor.

D. Lay tile from center marks established with principal walls discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid use of cut widths less than one half tile at perimeters. Lay tile square to room axis, unless otherwise indicated.

E. Adhere tile flooring to substrate using full spread of adhesive.

F. Lay tile using conventional procedures for laying resilient tile, placing tile carefully and firmly in position and as level as possible. Butt tile cleanly, evenly and snugly against adjacent tile.

G. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged, if cartons are so numbered. Do not install broken, cracked or chipped tiles.

H. Roll and cross roll floor with 150 pound sectional roller continuously while tile is being laid. Use hand roller in areas that cannot be reached with large roller. Cease rolling when rolling has no more effect.

I. Do not subject floors to traffic until adhesive is dry and hard and sealers and finishes are applied.

J. Remove and replace tiles that are not flat, including lipped, cupped, curved, or poorly adhered tile. Remove rejected tile from site.

K. Do not bridge expansion joints and construction joints. Provide cut tile at these areas with sealant.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide on-site services of tile manufacturer or authorized distributor for technical assistance during preparation and installation.

3.5 CLEANING AND PROTECTION

A. Upon completion of installation and curing of adhesive, apply sealant to entire perimeter and around columns, door frames, and other joints and penetrations to prevent water penetration into the adhesive layer due to accidental or maintenance (mopping) water accumulation.

B. Remove excess adhesives, dirt, stain and other foreign material. Clean floors in accordance with tile manufacturer's instructions.

C. Protect finished installation at all times. Repair or replace flooring damaged prior to final acceptance of installation by Owner.

END OF SECTION

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.

2. Resilient Stair accessories
3. Resilient molding accessories for carpet tile edges and nosings

B. Related Sections:
1. Division 09 Section “Carpet Tile” for carpet tile floor coverings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Product Data for adhesives, including printed statement of VOC content.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.

C. Samples for Initial Selection: For each type of product indicated.

D. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

E. Product Schedule: For resilient products.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Mockups: Provide resilient products with mockups specified in other Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove (base with toe).

B. Minimum Thickness: 0.125 inch (3.2 mm).

C. Height: 4 inches (102 mm).

D. Lengths: Coils in manufacturer's standard length.

E. Outside Corners: Job formed.

F. Inside Corners: Job formed

G. Finish: Satin.

H. Colors and Patterns: As selected by Architect from full range of industry colors.

I. Rubber Wall Base:

1. Available manufacturers include, but are not limited to, the following:
   a. Roppe.
   b. Burke.
   c. Johnsonite.

2. Color and Pattern: As scheduled on drawings.
3. Style: Cove with top-set toe.and straight with no toe as scheduled
4. Minimum Thickness: 1/8 inch (3.2 mm).
5. Height: 4 inches.
6. Lengths: Coils in lengths standard with manufacturer, but not less than 96 feet (29.26 m).
7. Outside Corners: Job formed.
8. Inside Corners: Job formed.
9. Ends: Premolded.
10. Surface: Smooth.

2.2 RESILIENT STAIR ACCESSORIES

A. Rubber Stair Tread/Riser - integral tread rider product and matching Landing Tile: Products of style suitable for use indicated and complying with FS RR-T-650, Composition A and with requirements specified in the Resilient Accessory Schedule.

B. Rubber Stair Treads and Accessories: Where this designation is indicated, provide rubber stair treads and accessories complying with the following:

1. Available Manufacturers: As follows
   Johnsonite
   Mannington
   Roppe

2. Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns produced for rubber stair treads and accessories complying with requirements indicated

3. Rubber Stair Treads with integral Riser: Type 2 design (designed) products complying with the following requirements:
   a. Type 2 Design Raised-line pattern.
   b. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
   c. Nosing Height: 1-1/2 inches (38.1 mm indicated above.]
   d. 5/16-inch (7.9-mm) tapering to 3/16 inch (4.8 mm) at back edge
   e. Integral Riser Skirt: integral with nosing assembly
   f. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units

2.3 RESILIENT MOLDING ACCESSORIES

A. Description: Carpet edge for glue-down applications, Nosing for carpet.

B. Material: Rubber.

C. Profile and Dimensions: As indicated.

D. Colors and Patterns: As selected by Architect from full range of industry colors.

E. Rubber Accessory Molding:

1. Available Manufacturers include, but are not limited to, the following:
   a. Johnsonite.
   b. Roppe.
   c. Burke.

2. Color: As selected by Architect from manufacturer's full range of colors produced for rubber accessory molding complying with requirements indicated.
3. Product Description:
   a. Reducer strip for resilient flooring.
   b. Tile and carpet joiner.
   c. Resilient edge for carpet.
4. Profile and Dimensions: As indicated on drawings.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

   a. Cove Base Adhesives: Not more than 50 g/L.
   b. Rubber Floor Adhesives: Not more than 60 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Accessories: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Use stair-tread-nose filler, according to resilient tread manufacturer's written instructions, to fill nosing substrates that do not conform to tread contours.

E. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096516.13 - LINOLEUM FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Linoleum sheet flooring.

2. Metal edge trim

3. Sound Control Underlayment to provide Min. IIC rating of 50.

B. Related Sections:

1. Division 01 Section “Sustainable Design Requirements” for IEQ Credits 4.1, MR Credits 4 and 5.

2. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with linoleum floor covering.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittal:

1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

2. Product Data for Credit MR 4 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

D. Samples for Initial Selection: For each type of floor covering indicated.

1. Include similar Samples of installation accessories involving color selection.

E. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch (152-by-230-mm) sections of each color and pattern of floor covering required.

1. Heat-Welding Bead: Include manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.

F. Heat-Welded Seam Samples: For each floor covering product and welding bead color and pattern combination required; with seam running lengthwise and in center of 6-by-9-inch (152-by-230-mm) Sample applied to rigid backing and prepared by Installer for this Project.

G. Product Schedule: See drawings.

H. Qualification Data: For qualified Installer.

I. Maintenance Data: For each type of floor covering to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for floor coverings including integral-flash-cove-base and resilient base and accessories.

a. Size: Minimum 100 sq. ft. (9.2 sq. m) for each type, color, and pattern in locations directed by Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 90 deg F (32 deg C).

1. Floor Tile: Store on flat surfaces.
2. Sheet Flooring: Store rolls upright.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor coverings during the following time periods:

1. 72 hours before installation.
2. During installation.
3. 72 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 72 hours after floor covering installation.

E. Install floor coverings after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sheet Flooring: Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, in roll form and in full roll width for each color, pattern, and type of sheet flooring installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available manufacturers' products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong World Industries, Inc.
2. Forbo Flooring, Inc. Basis of Design. Marmoleum,
3. Tarkett Inc.

2.2 LINOLEUM FLOOR COVERING

A. Sheet Flooring: ASTM F 2034, Type I, linoleum sheet with backing.

1. Roll Size: In manufacturer's standard length by not less than 78 inches (1980 mm) wide.

B. Seaming Method: Heat welded.

C. Thickness: 3.5 mm.

D. Marmoleum Decibel

E. Colors and Patterns: See drawings, or if not indicated, as selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit products and substrate conditions indicated.

1. Use adhesives that have a VOC content of not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Heat-Welding Bead: Solid-strand product of linoleum floor covering manufacturer.

1. As selected by Architect from manufacturer's standard colors.

D. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

E. Integral-Flash-Cove-Base Accessories:

1. Cove Strip: 1-inch (25.4-mm) radius provided or approved by manufacturer.
2. Cove-Base Cap Strip: **Square metal cap** provided or approved by manufacturer.
3. Metal Outside corner

F. Sound Control Underlayment: Resilient Rubber underlayment, made from 90% recycled rubber into 48 inch nominal width rollgoods.

1.Products include , but are not limited to the following:

QT SCU 5mm thickness as manufactured by ECore international or

2. Additional Manufacturers include:

Forbo

Armstrong

Tarkett

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreigndeposits that might interfere with adhesion of floor coverings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

   a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
   b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor coverings until they are same temperature as space where they are to be installed.

1. Move floor coverings and installation materials into spaces where they will be installed at least 72 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

3.3 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions for installing floor coverings.

B. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.

C. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

D. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on subfloor. Use chalk or other nonpermanent marking device.

E. Install floor coverings on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of floor covering installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.

F. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

G. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

3.4 LINOLEUM SHEET FLOORING INSTALLATION

A. Unroll sheet floorings and allow them to stabilize before cutting and fitting.

B. Lay out sheet floorings as follows:

1. Maintain uniformity of floor covering direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in floor covering substrates.
3. Match edges of floor coverings for color shading at seams.
4. Avoid cross seams.
5. Eliminate deformations that result from hanging method used during drying process (stove bar marks).

C. Integral-Flash-Cove Base: Cove linoleum floor covering up vertical surfaces. Support floor covering at horizontal and vertical junction with cove strip. Butt at top against cap strip. Cover corner joints with corner profile edge strip.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.

B. Perform the following operations immediately after completing floor covering installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor coverings before applying liquid floor polish.

1. Apply three coat(s).

E. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover floor coverings until Substantial Completion.

END OF SECTION 096516.13

SECTION 096516 - SHEET VINYL SAFETY FLOOR COVERINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes sheet vinyl Safety flooring in Kitchen

B. Related Sections include the following:

1. Division 9 Section for Resilient Flooring and Base" for base installed with sheet floorings.

1.3 SUBMITTALS

A. Product Data: For each type of product specified.

B. LEED Submittals:

1. Credit EQ 4.1: Manufacturers' product data for adhesives, including printed statement of VOC content.
2. Product Data for Credit MR 4.1 **and Credit MR 4.2**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement that indicates costs for each product having recycled content.

C. Shop Drawings: Show location of seams and edges. Indicate location of columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutout locations.

D. Product Certificates: Signed by manufacturers of sheet vinyl floor coverings certifying that each product furnished complies with requirements.

E. Maintenance Data: For sheet vinyl floor coverings to include in the maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type, color, and pattern of sheet vinyl floor covering specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

B. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet vinyl floor coverings and installation accessories to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F (10 and 32 deg C).

C. Store rolls upright.

D. Move sheet vinyl floor coverings and installation accessories into spaces where they will be installed at least 48 hours before installation, unless longer conditioning periods are recommended in writing by manufacturer.

1.6 PROJECT CONDITIONS

A. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C) in spaces to receive sheet vinyl floor coverings for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After postinstallation period, maintain a temperature of not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

B. Do not install sheet vinyl floor coverings until they are at the same temperature as the space where they are to be installed.

C. Close spaces to traffic during sheet vinyl floor covering installation and for time period after installation recommended in writing by manufacturer.

D. Install sheet vinyl floor coverings and accessories after other finishing operations, including painting, have been completed.

E. Where demountable partitions and other items are indicated for installation on top of sheet vinyl floor coverings, install floor coverings before these items are installed.

F. Do not install sheet vinyl floor coverings over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by floor covering manufacturer's recommended bond and moisture test.

PART 2 - PRODUCTS

2.1 SHEET VINYL FLOOR COVERINGS

A. Unbacked Sheet Vinyl Floor Coverings:

Altro suprema in color/pattern as selected by Architect

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by floor covering manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit sheet vinyl floor covering and substrate conditions indicated.

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.

D. Color: **As selected by Architect from manufacturer's full range** .

E. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of sheet vinyl floor coverings, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of sheet vinyl floor coverings will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for floor covering installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by floor covering manufacturer.
2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving resilient flooring.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with sheet vinyl floor covering manufacturer's written installation instructions for preparing substrates indicated to receive sheet vinyl floor coverings.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Broom and vacuum clean substrates to be covered immediately before installing sheet vinyl floor coverings. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. General: Comply with sheet vinyl floor covering manufacturer's written installation instructions.

B. Unroll sheet vinyl floor coverings and allow them to stabilize before cutting and fitting, if recommended in writing by manufacturer.

C. Lay out sheet vinyl floor coverings to comply with the following requirements:

1. Maintain uniformity of sheet vinyl floor covering direction.
2. Arrange for a minimum number of seams and place them in inconspicuous and low-traffic areas, and not less than 6 inches (150 mm) away from parallel joints in flooring substrates.
3. Match edges of sheet vinyl floor coverings for color shading and pattern at seams according to manufacturer's written recommendations.
4. Avoid cross seams.

D. Scribe, cut, and fit sheet vinyl floor coverings to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

E. Extend sheet vinyl floor coverings into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, nonstaining marking device.

G. Install sheet vinyl floor coverings on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.

H. Adhere sheet vinyl floor coverings to flooring substrates to comply with floor covering manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Produce completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

J. Hand roll sheet vinyl floor coverings in both directions from center out to embed floor coverings in adhesive and eliminate trapped air. At walls, door casings, and other locations where access by roller is impractical, press floor coverings firmly in place with flat-bladed instrument.

3.4 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing sheet vinyl floor coverings:

1. Remove adhesive and other surface blemishes using cleaner recommended by floor covering manufacturer.
2. Sweep or vacuum floor thoroughly.
3. Do not wash floor covering until after time period recommended by floor covering manufacturer.
4. Damp-mop floor to remove marks and soil.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by floor covering manufacturer.

1. Apply protective floor polish to sheet vinyl floor covering surfaces that are free from soil, visible adhesive, and surface blemishes, if recommended in writing by manufacturer.

   a. Use commercially available product acceptable to floor covering manufacturer.
   b. Coordinate selection of floor polish with Owner's maintenance service.

2. Cover sheet vinyl floor coverings with undyed, untreated building paper until inspection for Substantial Completion.
3. Do not move heavy and sharp objects directly over sheet vinyl floor coverings. Place plywood or hardboard panels over floor coverings and under objects while they are being moved. Slide or roll objects over panels without moving panels.

C. Clean sheet vinyl floor coverings not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean floor coverings according to manufacturer's written recommendations.

1. Before cleaning, strip protective floor polish that was applied after completing installation only if required to restore polish finish and if recommended by floor covering manufacturer.
2. After cleaning, reapply polish to floor surfaces to restore protective floor finish according to floor covering manufacturer's written recommendations. Coordinate with Owner's maintenance program.

END OF SECTION 096516

SECTION 096566 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Resilient Sports Flooring for Exercise room and MultiPurpose rooms as scheduled

B. Related Sections include the following:
   1. Division 9 Section **"Resilient Wall Base and Accessories"** for wall base and accessories installed with athletic flooring.
   2. Division 9 Section **"Resilient Tile Flooring"** for resilient flooring installed in areas other than athletic-activity spaces.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

   1. Credit EQ 4.1: Manufacturers' product data for adhesives, including printed statement of VOC content.

C. Shop Drawings: Show installation details including **layout, colors, widths, and dimensions of lane markings**.

D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and patterns available for flooring. **Include charts showing colors and glosses of line and marker paint.**

E. Samples for Verification: For each type, color, and pattern of flooring indicated, 6-inch- (150-mm-) square samples of same thickness and material indicated for the Work. **Include sample sets showing line and marker paint colors applied to flooring.**

F. Maintenance Data: For each type of flooring indicated to include in maintenance manuals specified in Division 1.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

B. Store materials to prevent deterioration. **Store rolls upright.**

C. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer. Do not install products until they are at the same temperature as the space where they are to be installed.

1.5 PROJECT CONDITIONS

A. Install products after other finishing operations, including painting, are completed.

B. Adhesively Applied Products: As follows:

1. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C) in installation spaces for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After postinstallation period, maintain a temperature of not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
2. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.
3. Do not install products over concrete slabs until slabs have cured and are dry enough to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Furnish not less than 10 linear feet (3 linear m) in roll form for each 500 linear feet (150 linear m) or fraction thereof, of each type, color, and pattern of **sheet** flooring installed.
2. Deliver extra materials to Owner.

1.7 WARRANTY

A. Special Project Warranty: Submit Installer's warranty, signed by Installer, covering the Work of this Section, including all components of flooring system including striping, for the following warranty period:

1. Warranty Period: FIVE years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 RUBBER SHEET FLOOR COVERING

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are limited to, the following:

1.Mondo Advance

B. Prefabricated rubber athletic flooring, calendered and vulcanized with a base of natural and synthetic rubbers, stabilizing agents and pigmentation, . Manufactured in two layers which are vulcanized together. The shore hardness of the top layer will be greater than that of the bottom layer; shore hardness of layers to be recommended by the Manufacturer and the limits specified.

C. Material: **Rubber and rubber shock-absorbent layer, vulcanized together**.

D. Installation Method: Adhered.

E. Traffic-Surface: Texture:

F. Roll Size: **Not less than 72 inches** wide by longest length that is practical to minimize splicing during installation.

G. Thickness: nominal 6.0 mm

H. Color: **As selected by Architect** .

2.2 ACCESSORIES

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by floor covering manufacturer.

A. Installation Adhesive: Water-resistant type CAPABLE OF RESISTING UP TO 5 LBS OF VAPOR DRIVE as recommended in writing by manufacturer for substrate and conditions indicated.

1. Use adhesive that has a VOC content of **60** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements.

B. Concrete Substrates: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond, moisture, and pH tests recommended in writing by flooring manufacturer.
2. Substrate finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving resilient flooring.
3. Substrates are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

B. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

C. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION, GENERAL

A. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

B. Extend floor coverings into toe spaces, door reveals, closets, and similar openings, unless otherwise indicated.

C. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on finish flooring. Use nonpermanent, nonstaining marking device.

D. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 SHEET FLOORING INSTALLATION

A. Lay out sheet flooring to comply with the following requirements:

1. Maintain uniformity of flooring direction.
2. Arrange for a minimum number of seams and place them in inconspicuous and low-traffic areas, and not less than 6 inches (150 mm) from parallel joints in flooring substrates.
3. Match edges of sheet flooring for color shading and pattern at seams.
4. Avoid cross and butt seams.
5. Weight seams for period recommended by manufacturer.

B. Welded Seams: Rout joints and heat weld with welding bead, or chemical treatment as standard with manufacturer, to permanently fuse sections into a monolithic floor finish. Prepare, weld, and finish seams according to manufacturer's written instructions and ASTM F 1516 to produce surfaces flush with adjoining floor covering surfaces.

3.5 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing flooring products:

1. Remove adhesive and other surface blemishes using cleaner recommended in writing by flooring manufacturer.
2. Sweep and vacuum floor thoroughly.
3. Do not wash floor until after waiting period recommended in writing by flooring manufacturer.
4. Damp mop floor to remove marks and soil using method and cleaner recommended in writing by flooring manufacturer.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.
   1. Do not move heavy or sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 096566

SECTION 096813 – TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes carpet tile and installation provided under State Contract and installed by State Approved Installer. An allowance of $21.00 per yard will be required for Bid

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for IEQ Credits 4.1 and 4.3
2. Division 9 Section "Resilient Flooring and Base” for resilient wall base and accessories installed with carpet tile.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation methods.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Existing flooring materials to be removed.
3. Existing flooring materials to remain.
4. Carpet tile type, color, and dye lot.
5. Type of subfloor.
6. Type of installation.
7. Pattern of installation.
8. Pattern type, location, and direction.
9. Pile direction.
10. Type, color, and location of insets and borders.
11. Type, color, and location of edge, transition, and other accessory strips.
12. Transition details to other flooring materials.

C. LEED Submittal:

1. Product Data for Credit IEQ 4.1: For adhesives and primers used inside, including printed statement of VOC content.

2. Product Data for Credit IEQ 4.3:

   a. For carpet tile, documentation indicating compliance with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.
   b. For installation adhesive, including printed statement of VOC content.

D. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

   1. Carpet Tile: Full-size Sample.
   2. Exposed Edge Stripping and Accessory: 12-inch- (300-mm-) long Samples.

E. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.

F. Maintenance Data: For carpet tile to include in maintenance manuals specified in Division 1. Include the following:

   1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
   2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

C. Product Options: Products and manufacturers named in Part 2 establish requirements for product quality in terms of appearance, construction, and performance. Other manufacturers' products comparable in quality to named products and complying with requirements may be considered. Refer to Division 1 Section "Substitutions."

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."

B. Environmental Limitations: Do not install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tile over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tile, install carpet tile before installing these items.

1.7 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Carpet Tile Warranty: Written warranty, signed by carpet tile manufacturer agreeing to replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

1. Warranty Period: **10** years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units, not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Carpet Tile Models and Types

F1 is the field carpet tile used in the majority of the spaces
F2 is the field carpet tile used in lounge/common spaces
F3 is an accent carpet tile used in some of the lounge/common spaces together with type F2

B. Other manufacturers may submit on specified products. Due to the color pallete selected for the work, submitted products must comply with color and pattern requirements as well as construction specified herein. SBR backings are prohibited

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and that is recommended by carpet tile manufacturer.

1. VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D 5116:

   a. Total VOCs: 10.00 mg/sq. m x h.
   b. Formaldehyde: 0.05 mg/sq. m x h.
   c. 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Verify that substrates and conditions are satisfactory for carpet tile installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

   1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
   2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
   3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 13, "Carpet Modules (Tiles)."

B. Installation Method: As recommended in writing by carpet tile manufacturer for Glue-down; install every tile with releasable adhesive

C. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

F. Install pattern parallel to walls and borders unless otherwise indicated

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect carpet tile to comply with CRI 104, Section 15, "Protection of Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099120 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and field painting including,but not limited to the following:

1. Doors and frames.
2. Mechanical units.
3. Interior gypsum board assemblies.
4. Interior partitions
5. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Related Sections include the following:

1. Division 01 Section “Sustainable Design Requirements” for IEQ Credit 4.1/4.2

2. Division 7 Section for Water Repellant coatings (exterior applications).
3. Division 8 Section "Steel Doors and Frames" for shop priming steel doors and frames.
4. Division 9 Section "Gypsum Board Assemblies" for surface preparation for gypsum board.
5. Division 9 Section “High Performance Coatings” for reinforced epoxy coatings.
6. Divisions 23 and 26: Painting of mechanical and electrical work other than exposed duct, piping and conduit as specified herein, is specified in Divisions 23 and 26, respectively.

C. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

1 Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment. Include painting of exposed radial duct. ‘

2. VOC compliance for products used in the work is a requirement of the work of this section.

D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, sealants between dissimilar materials, and labels.

1. Prefinished items include the following factory-finished components:

a. Architectural woodwork and casework.

b. Metal toilet enclosures.
c. Finished mechanical and electrical equipment.
d. Light fixtures.
e. Distribution cabinets.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

a. Furred areas.
b. Ceiling plenums.
c. Pipe spaces.
d. Duct shafts.

3. Finished metal surfaces include the following:

a. Anodized aluminum.
b. Stainless steel.
c. Chromium plate.

4. Operating parts include moving parts of operating equipment and the following:

a. Valve and damper operators.
b. Linkages.
c. Sensing devices.
d. Motor and fan shafts.

5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

B. LEED Submittal:

1. Product Data for Credit IEQ 4.1/4.2: For paints, including printed statement of VOC content and chemical components.

2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.

   a. Submit Samples for Architect’s review of color and texture only

D. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.

a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F (10 and 32 deg C).

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F (7.2 and 35 deg C).

C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner.

1. Quantity: Furnish the Owner with extra paint materials in the quantities indicated below:

   a. Interior, Low-Luster Acrylic Finish: 1 gals of each color applied.
   b. Interior Epoxy coatings: 1 gal of each color applied
   c. Interior, Semigloss Acrylic Enamel: 2 gal. (7.57 L) of each color applied.
   d. Interior Clear Coat: 5 gals.
   e. Exterior, Semigloss Alkyd: 1 gal. of each color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in the paint schedules as a standard of quality for the work

B. Manufacturers Names: The following manufacturers provide products that may be incorporated into the Work:

   1. Benjamin Moore.
   2. Columbia Paint .
   3. ICI Paints.
   4. Kwal-Paints.
   5. PPG.
   6. Sherwin-Williams.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

   1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
   2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
   3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
   4. Floor Coatings: VOC not more than 100 g/L.
   5. Shellacs, Clear: VOC not more than 730 g/L.
   6. Shellacs, Pigmented: VOC not more than 550 g/L.
   7. Flat Topcoat Paints: VOC content of not more than 50 g/L.
   8. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
   9. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
   10. Floor Coatings: VOC not more than 100 g/L.

11. Shellacs, Clear: VOC not more than 730 g/L.
12. Shellacs, Pigmented: VOC not more than 550 g/L.
13. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
14. Dry-Fog Coatings: VOC content of not more than 400 g/L.
15. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
16. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:

a. Acrolein.
b. Acrylonitrile.
c. Antimony.
d. Benzene.
e. Butyl benzyl phthalate.
f. Cadmium.
g. Di (2-ethylhexyl) phthalate.
h. Di-n-butyl phthalate.
i. Di-n-octyl phthalate.
j. 1,2-dichlorobenzene.
k. Diethyl phthalate.
l. Dimethyl phthalate.
m. Ethylbenzene.
n. Formaldehyde.
o. Hexavalent chromium.
p. Isophorone.
q. Lead.
r. Mercury.
s. Methyl ethyl ketone.
t. Methyl isobutyl ketone.
u. Methylene chloride.
v. Naphthalene.
w. Toluene (methylbenzene).
x. 1,1,1-trichloroethane.
y. Vinyl chloride.

D. Material Quality: Provide manufacturer's best-quality premium paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

E. Colors: Provide color selections made by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Verify that all sealants have been applied in locations that abut areas to be painted.
3. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.

   a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
   b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer on metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under

moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:

1. Piping, pipe hangers, and supports.
2. Heat exchangers.
3. Tanks.
4. Ductwork.
5. Insulation.
6. Motors and mechanical equipment.
7. Accessory items.

G. Electrical items to be painted include, but are not limited to, the following:

1. Conduit and fittings.
2. Switchgear.
3. Panelboards.

H. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

J. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:

1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.
2. The testing agency will perform appropriate tests for the following characteristics as required by the Owner:

   a. Quantitative material analysis.
   b. Abrasion resistance.
   c. Apparent reflectivity.
   d. Flexibility.
   e. Washability.
   f. Absorption.
   g. Accelerated weathering.
   h. Dry opacity.
   i. Accelerated yellowness.
   j. Recoating.
   k. Skinning.
   l. Color retention.
   m. Alkali and mildew resistance.

3. The Owner may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements. The Contractor shall remove non-complying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

3.5 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 EXTERIOR PAINT SCHEDULE

A. Ferrous Metal (primer is not required on shop-primed items):
   2. Alkyd System System: MPI EXT 5.1D.

      a. Prime Coat: Surface Tolerant Metal Primer.
         1) CPC Industrial Coatings Universal H2O Metal Primer, CX05550PP
         2) ICI Paints: Devoe Coatings, Devguard Multi-Purpose Primer, 4160.
         3) PPG: Speedhide, Oil Alkyd Primer, 6-212.
         4) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series

      b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
      c. Topcoat: MPI #9, Exterior Acrylic Enamel, Gloss, MPI Gloss Level 6.
         1) ICI Paints: Devoe Coatings, Devguard Alkyd Enamel, 4308-0100.
         2) PPG: Speedhide I, Ext. Alkyd Enamel – Gloss, 6-282.
         3) S-W Waterbased Industrial Enamel, B53-300 Series

B. Zinc-Coated (Galvanized) Metal:

   1. Alkyd System:

   Prime Coat: Cementitious Primer.

         1) Sherwin-Williams: Industrial & Marine S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series
         2) CPC Industrial Coatings Universal H2O Metal Primer, CX05550PP

      d. Intermediate Coat: Exterior alkyd enamel matching topcoat.
      e. Topcoat: Exterior Alkyd Enamel, Gloss, MPI Gloss Level 6.
         1) ICI Paints: Devoe Coatings, Devguard Alkyd Enamel, 4308-0100.
         2) S-W Waterbased Industrial Enamel, B53-300 Series

3.8 INTERIOR PAINT SCHEDULE

A. Gypsum Board (Walls and Ceilings): Ceiling contrasting color as scheduled.

   1. High-Performance Acrylic Latex System: MPI INT 9.2B.

      a. Prime Coat: MPI #50, Interior Latex Primer Sealer.
         1) CPC Premium Pro Base-Coat Wallboard Primer/Sealer CX02734PP
         2) S-W ProGreen 200 Interior Latex Primer, B28W600

      b. Intermediate Coat: Interior W.B. Light Industrial Coating matching topcoat.

      c. Topcoat: Interior W.B. Light Industrial Coating, MPI Gloss Level 3.
         1) CPC Premium Pro Plus Acry-Plus Interior Latex SemiGloss, CX02252WB
         2) S-W ProMar 200 SemiGloss, B31-W2651 Series

B. Gypsum Board (Shower and Toilet Room Walls and Ceilings):

1. 2 Component Epoxy Waterborne System: MPI INT 9.2F.

a. Prime Coat: MPI #50, Interior Latex Primer Sealer.
1) CPC Premium Pro Base-Coat Wallboard Primer/Sealer CX02734PP
2) S-W ProGreen 200 Interior Latex Primer, B28W600

b. Intermediate Coat: Epoxy matching topcoat.

c. Topcoat: Epoxy, MPI #115, Interior/Exterior Epoxy (water based).
1) CPC no product – recommend S-W Waterbased Catalyzed Epoxy, B70W211/ B60V25
2) S-W Waterbased Catalyzed Epoxy, B70W211/ B60V25

C. Honed Concrete Masonry Units – Anti-Graffiti coating

Clear Coat – that does not alter appearance of CMU when in place.
1. Two Finish Coats -

a. BASF – ProtectoSil antigraffiti

b. Prosoco – Blok-Guard AntiGraffiti

D. Ferrous Metal and exposed structural steel:

1. Alkyd System:
a. Prime Coat: MPI #79, Alkyd Anti-Corrosive Metal Primer.
1) CPC Industrial Coatings Universal H2O Metal Primer, CX05550PP
b. 2) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series

c. Intermediate Coat: Alkyd matching topcoat.
d. Topcoat: MPI #47, Interior alkyd, Semi-Gloss, MPI Gloss Level 5.
1) CPC Hi-Performance Coatings Acry-Shield Semi-Gloss Enamel, CX05262WB
2) S-W DTM Acrylic S/G B66W211

E. Door Frames – Restricted to Spray applied Finish only
1. Prime Coat:
1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series

2. Finish coat
1) S-W Bond Flex Waterbased acrylic coating Aluminum Finish.

F. Dryfall Coating: Exposed Deck :

1. Acrylic Flat Enamel applied at 1.5 mil dry film thickness.

2. Provide surface prep solvent wipe down, test for chromate passivation and/or recommended primer for galvanized surfaces as recommended by manufacturer
a. Coronado DTM Acrylic Dry-Fall
b. ICI Aquacrylic Dryfall Flat
c. Sherwin Williams Waterborne Acrylic Dry-Fall

G. Exposed structural steel:

a. High-Gloss Finish: One finish coat over an intermediate coat and a primer.

1. Primer: Epoxy primer applied at spreading rate recommended by manufacturer.

ICI: Devran 224HS High Build Epoxy Coating.
S-W: Recoatable Epoxy Primer B67 Series/B67V5.
Tnemec: Series 90-97 Tneme Zinc

2. Intermediate Coat: Epoxy applied atspreading rate recommended by manufacturer to achieve a dry film thickness of 3.0 to 5.0 mils (0.076 to 0.127 mm).

S-W: Heavy Duty Epoxy B58W610 Series. Macropoxy 646 Fast cure
Tnemec: Series 27 F. C. Typoxy Polyamide Epoxy

3. Topcoat: Aliphatic polyurethane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils (0.038 to 0.102 mm).

ICI: Devthane 369 Aliphatic Urethane Gloss Enamel. 2 coats required
S-W: Corothane II Gloss B65W300 Series. High Solids
Tnemec: Series 74 Endura-Shield.

END OF SECTION 099120

SECTION 101400 – INTERIOR SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior panel signs necessary to comply with code required minimums and room signage , provided and installed by Contractor.

2. Signage package to be purchased through the State Contract from Utah Correctional Industries Attn : Perri Flory

B. Related Sections include the following:
1. Division 10 Section "Signs" for exterior lettering
2. Exterior parking signs are as shown on Site Drawings..

1.3 SUBMITTALS

A. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights and location layout, spacing, reinforcement, accessories, and installation details.

1. Provide message list for each sign, including large-scale details of wording, lettering, and braille layout.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.

C. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

1.5 COORDINATION

A. For signs supported by or anchored to permanent construction, furnish templates for installation of anchorage devices.

PART 2 - PRODUCTS

2.1 ACCESSORIES

A. Mounting Methods: Use mechanical mounting methods with vandalproof fasteners through backing plate.

B. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

C. See Signage Schedule for types, sizes and content.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
3. Glass mounted signs: Where signage mounts to glass provide matching back panel on opposite side of glass to conceal tape mounts.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the method indicated below:

1. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 101400

WSU Residential Life Building 2 12-Apr-11

FIRST FLOOR

6" X 6" STANDARD ROOM SIGNS:

			$121.98
6" x 3"- TOP PIECE	ADA Number	101	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	123	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	133	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	134	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	137	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	137A	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	137B	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	137C	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	137D	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	137E	

6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	137F	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	137G	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	137H	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
6" X 3" ADA NUMBER SIGN ONLY:	**NOTE - INSERTS ONLY Flat smooth black back with tape. NO ENDCAPS/RAILS. These will be taped directly onto windows or walls.**		
			$24.89
6" x 3"- ADA SIGN	ADA Number	100A	
			$24.89
6" x 3"- ADA SIGN	ADA Number	104	
			$24.89
6" x 3"- ADA SIGN	ADA Number	100C	
			$24.89
6" x 3"- ADA SIGN	ADA Number	105	
			$24.89
6" x 3"- ADA SIGN	ADA Number	107	
			$24.89
6" x 3"- ADA SIGN	ADA Number	100D	
			$24.89
6" x 3"- ADA SIGN	ADA Number	108	
			$24.89
6" x 3"- ADA SIGN	ADA Number	109	
			$24.89
6" x 3"- ADA SIGN	ADA Number	110	
			$24.89
6" x 3"- ADA SIGN	ADA Number	100E	
			$24.89
6" x 3"- ADA SIGN	ADA Number	111	
			$24.89
6" x 3"- ADA SIGN	ADA Number	112	
			$24.89
6" x 3"- ADA SIGN	ADA Number	113	
			$24.89
6" x 3"- ADA SIGN	ADA Number	114	
			$24.89
6" x 3"- ADA SIGN	ADA Number	100F	
			$24.89
6" x 3"- ADA SIGN	ADA Number	115	
			$24.89
6" x 3"- ADA SIGN	ADA Number	116	
			$24.89
6" x 3"- ADA SIGN	ADA Number	117	

			$24.89
6" x 3"- ADA SIGN	ADA Number	100G	
			$24.89
6" x 3"- ADA SIGN	ADA Number	100H	
			$24.89
6" x 3"- ADA SIGN	ADA Number	118	
			$24.89
6" x 3"- ADA SIGN	ADA Number	119	
			$24.89
6" x 3"- ADA SIGN	ADA Number	120	
			$24.89
6" x 3"- ADA SIGN	ADA Number	100J	
			$24.89
6" x 3"- ADA SIGN	ADA Number	100K	
			$24.89
6" x 3"- ADA SIGN	ADA Number	121	
			$24.89
6" x 3"- ADA SIGN	ADA Number	122	
			$24.89
6" x 3"- ADA SIGN	ADA Number	124	
			$24.89
6" x 3"- ADA SIGN	ADA Number	126	
			$24.89
6" x 3"- ADA SIGN	ADA Number	127	
			$24.89
6" x 3"- ADA SIGN	ADA Number	128	
			$24.89
6" x 3"- ADA SIGN	ADA Number	100N	
			$24.89
6" x 3"- ADA SIGN	ADA Number	100P	
			$24.89
6" x 3"- ADA SIGN	ADA Number	129	
			$24.89
6" x 3"- ADA SIGN	ADA Number	130	
			$24.89
6" x 3"- ADA SIGN	ADA Number	100Q	
			$24.89
6" x 3"- ADA SIGN	ADA Number	131	
			$24.89
6" x 3"- ADA SIGN	ADA Number	136	
			$24.89
6" x 3"- ADA SIGN	ADA Number	136	
			$24.89
6" x 3"- ADA SIGN	ADA Number	136A	

6" X 6" ADA SPECIAL SIGNS :

			$108.72
6" X 6"- SINGLE PIECE	ADA Name	SUITES:	
	ADA Number	104 - 120	
			$108.72
6" X 6"- SINGLE PIECE	ADA Name	SUITES:	
	ADA Number	126 - 131	

6" X 6" ADA WHEELCHAIR ACCESSIBLE RESTROOM SIGNS :

			$108.72
6" X 6"- SINGLE PIECE	ADA Number	102A	
	ADA Name	WOMEN (with ADA logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Number	102B	
	ADA Name	UNISEX (with ADA man/woman logo)	
			$108.72

6" X 6"- SINGLE PIECE	ADA Number	102C	
	ADA Name	MEN (with ADA logo)	

6" X 6" ADA EXIT SIGNS WITH HANDICAP LOGO:

			$108.72
6" X 6"- EXIT SIGN	ADA Text	EXIT (with handicap logo)	
			$108.72
6" X 6"- EXIT SIGN	ADA Text	EXIT (with handicap logo)	
			$108.72
6" X 6"- EXIT SIGN	ADA Text	EXIT (with handicap logo)	
			$108.72
6" X 6"- EXIT SIGN	ADA Text	EXIT (with handicap logo)	
			$108.72
6" X 6"- EXIT SIGN	ADA Text	EXIT (with handicap logo)	
			$108.72
6" X 6"- EXIT SIGN	ADA Text	EXIT (with handicap logo)	
			$108.72
6" X 6"- EXIT SIGN	ADA Text	EXIT (with handicap logo)	

6" X 6" ADA STAIR SIGNS :

			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	

6" X 6" ADA STAIRWELL FLOOR ID SIGNS:

			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	1ST	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	1ST	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	1ST	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	1ST	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	1ST	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	1ST	
	ADA Text Line 2	FLOOR	

12" X 4" ADA ELEVATOR SIGN:

			$122.88
12" X 4"- SINGLE PIECE	ADA Text Line 1	IN CASE OF FIRE USE STAIRS	

SECOND FLOOR

6" X 6" STANDARD ROOM SIGNS:

			$121.98
6" x 3"- TOP PIECE	ADA Number	201	

6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
6" X 3" ADA NUMBER SIGN ONLY:	**NOTE - INSERTS ONLY Flat smooth black back with tape. NO ENDCAPS/RAILS. These will be taped directly onto windows or walls.**		
			$24.89
6" x 3"- ADA SIGN	ADA Number	200A	
			$24.89
6" x 3"- ADA SIGN	ADA Number	204	
			$24.89
6" x 3"- ADA SIGN	ADA Number	200C	
			$24.89
6" x 3"- ADA SIGN	ADA Number	205	
			$24.89
6" x 3"- ADA SIGN	ADA Number	207	
			$24.89
6" x 3"- ADA SIGN	ADA Number	200D	
			$24.89
6" x 3"- ADA SIGN	ADA Number	208	
			$24.89
6" x 3"- ADA SIGN	ADA Number	209	
			$24.89
6" x 3"- ADA SIGN	ADA Number	210	
			$24.89
6" x 3"- ADA SIGN	ADA Number	200E	
			$24.89
6" x 3"- ADA SIGN	ADA Number	211	
			$24.89
6" x 3"- ADA SIGN	ADA Number	212	
			$24.89
6" x 3"- ADA SIGN	ADA Number	213	
			$24.89
6" x 3"- ADA SIGN	ADA Number	214	
			$24.89
6" x 3"- ADA SIGN	ADA Number	200F	
			$24.89
6" x 3"- ADA SIGN	ADA Number	215	
			$24.89
6" x 3"- ADA SIGN	ADA Number	216	
			$24.89
6" x 3"- ADA SIGN	ADA Number	217	
			$24.89
6" x 3"- ADA SIGN	ADA Number	200G	
			$24.89
6" x 3"- ADA SIGN	ADA Number	200H	
			$24.89
6" x 3"- ADA SIGN	ADA Number	218	
			$24.89
6" x 3"- ADA SIGN	ADA Number	219	
			$24.89
6" x 3"- ADA SIGN	ADA Number	220	
			$24.89
6" x 3"- ADA SIGN	ADA Number	200K	
			$24.89
6" x 3"- ADA SIGN	ADA Number	222	
			$24.89
6" x 3"- ADA SIGN	ADA Number	224	
			$24.89
6" x 3"- ADA SIGN	ADA Number	224B	

			$24.89
6" x 3"- ADA SIGN	ADA Number	224D	
			$24.89
6" x 3"- ADA SIGN	ADA Number	224F	
			$24.89
6" x 3"- ADA SIGN	ADA Number	226	
			$24.89
6" x 3"- ADA SIGN	ADA Number	227	
			$24.89
6" x 3"- ADA SIGN	ADA Number	228	
			$24.89
6" x 3"- ADA SIGN	ADA Number	200N	
			$24.89
6" x 3"- ADA SIGN	ADA Number	200P	
			$24.89
6" x 3"- ADA SIGN	ADA Number	229	
			$24.89
6" x 3"- ADA SIGN	ADA Number	230	
			$24.89
6" x 3"- ADA SIGN	ADA Number	200Q	
			$24.89
6" x 3"- ADA SIGN	ADA Number	231	

6" X 6" ADA SPECIAL SIGNS :

			$108.72
6" X 6"- SINGLE PIECE	ADA Name ADA Number	SUITES: 204 - 220	
			$108.72
6" X 6"- SINGLE PIECE	ADA Name ADA Number	SUITES: 226 - 231	

6" X 6" ADA WHEELCHAIR ACCESSIBLE RESTROOM SIGNS :

			$108.72
6" X 6"- SINGLE PIECE	ADA Number ADA Name	202A WOMEN (with ADA logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Number ADA Name	202B UNISEX (with ADA man/woman logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Number ADA Name	202C MEN (with ADA logo)	

6" X 6" ADA EXIT SIGNS WITH HANDICAP LOGO:

			$108.72
6" X 6"- EXIT SIGN	ADA Text	EXIT (with handicap logo)	

6" X 3" EXIT SIGNS (NO ADA LOGO):

			$108.72
6" X 6"- EXIT SIGN	ADA Text	EXIT	

6" X 6" ADA STAIR SIGNS :

			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	

			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	

6" X 6" ADA STAIRWELL FLOOR ID SIGNS:

			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	2ND	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	2ND	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	2ND	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	2ND	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	2ND	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	2ND	
	ADA Text Line 2	FLOOR	

12" X 4" ADA ELEVATOR SIGN:

			$122.88
12" X 4"- SINGLE PIECE	ADA Text Line 1	IN CASE OF FIRE USE STAIRS	

THIRD FLOOR
6" x 6" STANDARD ROOM SIGNS:

			$121.98
6" x 3"- TOP PIECE	ADA Number	322	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	334	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	335	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			
			$121.98
6" x 3"- TOP PIECE	ADA Number	336	
6" x 1"- SLIDING PAPER INSERT (1ST)	Name		
	Title		
6" x 1"- BOTTOM PIECE	Department	Campus Life	
6" x 1"- NOTE HOLDER			

6" X 3" ADA NUMBER SIGN ONLY: **NOTE - INSERTS ONLY Flat smooth black back with tape. NO ENDCAPS/RAILS. These will be taped directly onto windows or walls.**

			$24.89
6" x 3"- ADA SIGN	ADA Number	300A	
			$24.89
6" x 3"- ADA SIGN	ADA Number	304	
			$24.89

6" x 3"- ADA SIGN	ADA Number	300C	
			$24.89
6" x 3"- ADA SIGN	ADA Number	305	
			$24.89
6" x 3"- ADA SIGN	ADA Number	307	
			$24.89
6" x 3"- ADA SIGN	ADA Number	300D	
			$24.89
6" x 3"- ADA SIGN	ADA Number	308	
			$24.89
6" x 3"- ADA SIGN	ADA Number	309	
			$24.89
6" x 3"- ADA SIGN	ADA Number	310	
			$24.89
6" x 3"- ADA SIGN	ADA Number	300E	
			$24.89
6" x 3"- ADA SIGN	ADA Number	311	
			$24.89
6" x 3"- ADA SIGN	ADA Number	312	
			$24.89
6" x 3"- ADA SIGN	ADA Number	313	
			$24.89
6" x 3"- ADA SIGN	ADA Number	314	
			$24.89
6" x 3"- ADA SIGN	ADA Number	300F	
			$24.89
6" x 3"- ADA SIGN	ADA Number	315	
			$24.89
6" x 3"- ADA SIGN	ADA Number	316	
			$24.89
6" x 3"- ADA SIGN	ADA Number	317	
			$24.89
6" x 3"- ADA SIGN	ADA Number	300G	
			$24.89
6" x 3"- ADA SIGN	ADA Number	300H	
			$24.89
6" x 3"- ADA SIGN	ADA Number	318	
			$24.89
6" x 3"- ADA SIGN	ADA Number	319	
			$24.89
6" x 3"- ADA SIGN	ADA Number	320	
			$24.89
6" x 3"- ADA SIGN	ADA Number	322	
			$24.89
6" x 3"- ADA SIGN	ADA Number	300K	
			$24.89
6" x 3"- ADA SIGN	ADA Number	322A	
			$24.89
6" x 3"- ADA SIGN	ADA Number	326	
			$24.89
6" x 3"- ADA SIGN	ADA Number	327	
			$24.89
6" x 3"- ADA SIGN	ADA Number	328	
			$24.89
6" x 3"- ADA SIGN	ADA Number	300N	
			$24.89
6" x 3"- ADA SIGN	ADA Number	300P	
			$24.89
6" x 3"- ADA SIGN	ADA Number	329	
			$24.89
6" x 3"- ADA SIGN	ADA Number	330	

			$24.89
6" x 3"- ADA SIGN	ADA Number	300Q	
			$24.89
6" x 3"- ADA SIGN	ADA Number	331	
			$24.89
6" x 3"- ADA SIGN	ADA Number	333	

6" X 6" ADA SPECIAL SIGNS :

			$108.72
6" X 6"- SINGLE PIECE	ADA Name	SUITES:	
	ADA Number	304 - 320	
			$108.72
6" X 6"- SINGLE PIECE	ADA Name	SUITES:	
	ADA Number	326 - 331	

6" X 6" ADA WHEELCHAIR ACCESSIBLE RESTROOM SIGNS :

			$108.72
6" X 6"- SINGLE PIECE	ADA Number	302A	
	ADA Name	WOMEN (with ADA logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Number	302B	
	ADA Name	UNISEX (with ADA man/woman logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Number	302C	
	ADA Name	MEN (with ADA logo)	

6" X 6" ADA STAIR SIGNS :

			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text	STAIR (with stair logo)	

6" X 6" ADA STAIRWELL FLOOR ID SIGNS:

			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	3RD	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	3RD	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	3RD	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	3RD	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	3RD	
	ADA Text Line 2	FLOOR	
			$108.72
6" X 6"- SINGLE PIECE	ADA Text Line 1	3RD	
	ADA Text Line 2	FLOOR	

12" X 4" ADA ELEVATOR SIGN:

			$122.88
12" X 4"- SINGLE PIECE	ADA Text Line 1	IN CASE OF FIRE USE STAIRS	
BLACK PLASTIC PIECE FOR BACK OF SIGNS ON GLASS:			
			$35.00
6" X 3"- BLACK PLASTIC BACK FOR GLASS MOUNT SIGNS		**60** - 6"X3" PIECES NEEDED	
6" X 6"- BLACK PLASTIC BACK FOR GLASS MOUNT SIGNS		**12** - 6"X6" PIECES NEEDED	

Building Total: **$11,959.94**

SECTION 102116 - SHOWER COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes shower compartments of the following type:

1. Fabricated seamless shower enclosure – ADA accessible and ADA adaptable
2. Provide complete with shower curtain, rod and recessed soap dish
3. Fabricated Ceiling panels to match shower enclosure
4. Tub Surrounds in Resident Manager units only

B. Related Sections include the following:

1. Division 23 for plumbing fixtures, trim, connections, drains, valves, pipes, and fittings.

1.3 SUBMITTALS

A. Product Data: For each type and style of shower compartment specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware, and fastenings.

B. Samples for Initial Selection: Manufacturer's color charts consisting of sections of actual units showing the full range of colors, textures, and patterns available for each type of compartment indicated.

1.4 COORDINATION

A. Coordinate location and requirements of service-utility connections, installation and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, and cleaning of shower compartments.

1.5 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer's Acrylic Finish Warranty: Written warranty, executed by manufacturer agreeing to replace shower compartments that develop surface defects within minimum warranty period indicated.

1. Minimum Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Type: modular, one-piece shower compartments.

a. Best Bath

b. Design Standards: Best Bath XCS4038A5T, XCS 6337A75B with tile band pattern in accent color

2. Type: modular, one-piece tub /shower

b. Best Bath

b. Design Standards: Best Bath LCTS 6034CP with tile band pattern in accent color

2.2 SHOWER COMPARTMENTS – ADA ACCESSIBLE

A. Fabricated Fiberglass Shower Compartments: Manufacturer's standard unit as indicated, one-piece fabricated unit with bulb threshold

1. Include fold-up seat and L-shaped, 1-1/2-inch diameter, grab bar. Provide a minimum of 3/4-inch thick plywood reinforcement band for securing accessories.
2. Color: As selected by Architect from manufacturer's full range of standard colors available.
3. Flame Spread: 75 or less.
4. Smoke Developed: 450 or less.
5. Shower curtain 6’6 tall with chrome rod
6. Collapsible T Bulb threshold

2.3 SHOWER COMPARTMENTS – ADA Adaptable

A. Fabricated Fiberglass Shower Compartments: Manufacturer's standard unit as indicated, one-piece fabricated unit with removable threshold

1. Provide blocking in place to receive <u>future</u> fold-up seat and L-shaped, 1-1/2-inch diameter, grab bar. Provide a minimum of 3/4-inch thick plywood reinforcement band for securing accessories.
2. Color: As selected by Architect from manufacturer's full range of standard colors available.
3. Flame Spread: 75 or less.
4. Smoke Developed: 450 or less.
5. Shower curtain 6’6 tall with chrome rod
6. Equip with removable threshold 3 ½ inch wide by 2 ½ inch high that can be removed if adaptable option is required.

2.4 TUB/ SHOWER COMPARTMENTS –

B. Fabricated Fiberglass Tub/ Shower Compartments: Manufacturer's standard unit as indicated, one-piece fabricated unit

1. Provide continuous blocking in place to receive L-shaped, 1-1/2-inch diameter, grab bar. Provide a minimum of 3/4-inch thick plywood reinforcement band for securing accessories.
2. Color: As selected by Architect from manufacturer's full range of standard colors available.
3. Flame Spread: 75 or less.
4. Smoke Developed: 450 or less.
5. Shower curtain with chrome rod

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, plumb, and level. Secure units in position with manufacturer's recommended anchoring devices and/or adhesives appropriate to substrate.

3.2 CLEANING AND PROTECTION

A. Clean surfaces to comply with manufacturer's instructions.

B. Provide final protection and maintain conditions that ensure shower compartments are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 102116

SECTION 102600 - IMPACT-RESISTANT WALL PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Scope Requirements and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following
   1. Corner guards to be installed at all outside corners not protected by masonry or casework/millwork.

B. Related Sections include the following:
   1. Division 01 Section “Sustainable Design Requirements”
   2. Division 5 Section "Metal Fabrications" for steel angle and bent plate corner guards fabricated from rolled metal.
   3. Division 6 Section "Rough Carpentry" for wood blocking for surface-mounted corner guards.

1.3 SUBMITTALS

A. Product Data: Include physical characteristics, for each impact-resistant wall protection system component indicated.

B. LEED Submittals:

   1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

      a. Include statement indicating costs for each product having recycled content.

   2. Product Data for Credit IEQ 4.1: For sealants, including printed statement of VOC content.

C. Shop Drawings: Show locations, extent, and installation details of each impact-resistant wall protection system component. Show methods of attachment to adjoining construction.

D. Samples for Verification: For the following products, showing the full range of color and texture variations expected in each impact-resistant wall protection system component. Prepare Samples from the same material to be used for the Work.
   1. Wall and Corner Guards: 12-inch- (300-mm-) long Samples of each type of impact-resistant wall protection system component required. Include examples of joinery, corners, and field splices.

E. Maintenance Data: For each impact-resistant wall protection system component to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed installation of impact-resistant wall protection system components similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experienced in manufacturing impact-resistant wall protection system components similar to those required for this Project and with a record of successful in-service performance.

C. Source Limitations: Obtain impact-resistant wall protection system component from a single source with resources to provide components of consistent quality in appearance and physical properties.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection system and are based on the specific system indicated. Other manufacturers systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architects approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Impact Strength: Provide impact-resistant wall protection system components with a minimum impact resistance of 25.4 ft-lbf/in. (1356 J/m) of width when tested according to ASTM D 256, Test Method A.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store wall surface-protection materials in original undamaged packages and containers inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
   1. Maintain room temperature within the storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored. Keep sheet material out of direct sunlight to avoid surface distortion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering impact-resistant wall protection system products that may be incorporated into the Work include, but are not limited to, the following:

   1. American Floor Products Co., Inc.
   2. Arden Architectural Specialties, Inc.
   3. Balco, Inc.
   4. Boston Retail Products.
   5. Construction Specialties, Inc.

6. IPC Door and Wall Protection Systems, Inc.
7. Koroseal Wall Protection Systems, Inc.
8. K. J. Miller Corp.
9. Pawling Corporation.
10. Tepromark International, Inc.
11. Tri-Guards, Inc.
12. Wilkinson Company, Inc.

B. Design Standard: IPC 160 High Impact Model.

2.3 MATERIALS

A. Extruded Rigid Plastic: Textured, chemical- and stain-resistant, high-impact-resistant, PVC or acrylic-modified vinyl plastic; thickness as indicated; with a minimum impact resistance of 25.4 ft-lbf/in. (1356 J/m) of width when tested according to ASTM D 256, Test Method A.

1. Color and Texture: As selected by Architect from manufacturer's full range for these characteristics.

B. metal screws, bolts, and other fasteners compatible with aluminum components, hardware, anchors, and other items being fastened. Use theftproof fasteners where exposed to view.

C. Adhesive: Type recommended by the manufacturer for use with material on the substrate indicated.

2.4 CORNER GUARDS

A. Surface-Mounted, Resilient Plastic Corner Guards: Surface-mounted, resilient plastic corner-guard assembly consisting of a snap-on-type plastic cover installed over a continuous aluminum retainer, height as indicated.

1. Cover: Extruded, rigid plastic, minimum 0.078 inch (2.0 mm) thick, in dimensions and profiles indicated.

a. Corner Radius: 1/4 inch (6.35 mm).

2. Retainer: Continuous, one-piece, extruded-aluminum retainer; minimum 0.062 inch (1.58 mm) thick.

3. Accessories: Provide prefabricated, injection-molded top cap and aluminum base with concealed splices, cushions, mounting hardware, and other accessories as required.

a. Top caps shall match color of plastic covers and shall be field adjustable for close alignment with snap-on plastic covers

2.5 FABRICATION

A. General: Fabricate impact-resistant wall protection systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including thicknesses of components.

B. Fabricate components with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions in which impact-resistant wall protection system components will be installed.
   1. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Install impact-resistant wall protection system components level, plumb, and true to line without distortions.
   1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Install retainers, mounting brackets, and other accessories according to the manufacturer's written instructions.

3.4 CLEANING

A. General: Immediately on completion of installation, clean metal components according to the manufacturer's written instructions.

B. Remove surplus materials, rubbish, and debris, resulting from installation, on completion of work and leave installation areas in neat, clean condition.

END OF SECTION 102600

SECTION 102800 – TOILET, BATH AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Toilet and bath accessories.
2. Underlavatory guards.
3. Ironing Centers at Laundry rooms

B. Related Sections include the following:

1. Division 8 Section “Mirror Glass” for unframed mirrors.
2. Division 10 Section "Toilet Compartments" for compartments and screens.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Samples: For each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

D. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated on Drawings in product schedule.

E. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.
1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering accessories that may be incorporated into the Work include, but are not limited to, the following:

1. Toilet Accessories:

a. A & J Washroom Accessories, Inc.
b. American Specialties, Inc.
c. Bobrick Washroom Equipment, Inc.
d. Bradley Corporation.
e. General Accessory Manufacturing Co. (GAMCO).
f. McKinney/Parker Washroom Accessories Corp.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.

C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).

E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.

F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

A. General: Logos are not permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET ACCESSORY SCHEDULE – PUBLIC TOILET ROOMS

A. Paper Towel Dispenser – Public Toilets: Owner Provided, Contractor installed

B. Toilet Tissue Dispenser Owner Provided, Contractor installed

C. Soap Dispenser: Public toilets: Owner Provided, Contractor installed

D. Grab Bar Where this designation is indicated, provide stainless-steel grab bar complying with the following:

1. Stainless-Steel Nominal Thickness: Minimum 0.05 inch (1.3 mm).
2. Mounting: Concealed with manufacturer's standard flanges and anchors
3. Gripping Surfaces: **Smooth, satin finish**
4. Outside Diameter: 1-1/2 inches (38 mm) for heavy-duty applications

5. 30, 36 AND 42 inch horizontal Bars, 18 inch vertical bar: Bobrick B6802

E. Sanitary Napkin Disposal Unit

1. Product Bobrick B353
2. Stainless Steel container with seamless 1.2 gal leakproof liner. Seamless flange for wall mount.

F. Mirror Unit: provide mirror unit for Public toilets complying with the following:
1. Products: Bobrick B-290 - sizes as noted
2. Stainless-Steel, Angle-Framed Mirror: Fabricate frame from stainless-steel angles in manufacturer's standard satin finish with square corners mitered to hairline joints and mechanically interlocked.

G. Mop and Broom Holder At all Janitor Closets with sinks provide mop and broom holder complying with the following:

1. Products: Bobrick B- 239 34" long

2. Mop and Broom Holder: 34-inch- (914-mm-) long unit fabricated of minimum nominal 0.0375-inch- (0.95-mm-) thick, stainless-steel hat channel with THREE spring-loaded, rubber, cam-type, mop/broom holders. FOUR hooks and continuouse shelf

3.4 SUITES – BATH AND TOILET ACCESSORIES

A. Toilet Tissue Dispenser: Where this designation is indicated, provide toilet tissue dispenser complying with the following:
1. Products: B-7686 double-roll at all residence units
2. Mounting: Surface mounted with concealed anchorage.
3. Material: Stainless steel.
4. Operation: Spindle with free delivery.
5. Capacity: 1 standard diameter-core tissue rolls.

B. Robe Hook, provide hook complying with the following:
1. Product: B-682
2. Single- Prong Unit: Satin stainless, hook with rectangular wall bracket and backplate for concealed mounting, formed for upper and lower hook

C. Mirror Unit: Provide mirror units complying with the following:

1.Stainless-Steel, Channel-Framed Mirror: Fabricate frame from stainless-steel channels in manufacturer's standard satin finish with square corners mitered to hairline joints and mechanically interlocked.

D. Shower rod, curtain and soap dish provided with shower unit.

E Towel Bars: Shower: 24 inch length gright polished stainless steel with ¾ inch diameter towel bar. 3 ¼ projection. Equal to Bobrick B-7674

F. Shower Curtain: Provide shower curtain complying with the following:

1. Antibacterial Shower Curtain: Minimum 10-oz. (284-g), nylon-reinforced vinyl or 0.008-inch-(0.2-mm-) thick vinyl material with integral antibacterial agent and corrosion-resistant grommets at minimum 6 inches (152 mm) o.c. through top hem.

    a. Size: Minimum 6 inches (152 mm) wider than opening by 72 inches (1828 mm) high.
    b. Color: **White**

2. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

G. Folding Shower Seat: Provide heavy-duty hinged seat designed to fold up against wall when not in use with stainless-steel support braces, hinges, frame, and fasteners; of all-welded construction; and complying with the following:

1. Products: Bobrick B-5181
2. ‘Configuration: L-shaped seat, designed for wheelchair access
3. Seat Material: **Phenolic or polymeric composite of slat-type or one-piece construction. Color as selected by Architect from mfr's full range**

H. Towel Hooks at Vanities: 6 x 36 inchc solid surfacing with eased edges with four towel hooks sim to A&J UX-110-SF

3.5 LAUNDRY ACCESSORIES

A. IRONING CENTERS

1. Built-in units of heavy gauge steel construction for semi-recessed or surface mounted installation.

2. Cabinet to include convenience outlet, timer , built-in worklight power indicator light and safety shut-off switch. Nominal dimensions of 16 w x 49 h x 4 dp

3. Hinged ironing board to be perforated steel 42 to 48 inch length

4. Board to be equipped with safety retainer and multiple height settings

5. Manufacturers include but are not limited to the following:

    Iron-A-Way Model A46

    Broan NuTone Model AVD50N

END OF SECTION 102800

SECTION 104413 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Portable fire extinguishers.
2. Fire-protection cabinets for portable fire extinguishers. Rated and non-rated

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

1. Fire Extinguishers: Include rating and classification.
2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of cabinet finish indicated.

C. Samples for Verification: For each type of exposed cabinet finish required, prepared on Samples of size indicated below and of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. Size: 6-by-6-inch- (150-by-150-mm-) square Samples.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide extinguishers listed and labeled by FM.

1.5 COORDINATION

A. Coordinate size of cabinets to ensure that type and capacity of fire extinguishers indicated and provided by Owner under separate Contract are accommodated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Portable Fire Extinguishers:

a. Amerex Corporation.
b. J.L. Industries, Inc.
c. Kidde: Walter Kidde, The Fire Extinguisher Co.
d. Larsen's Manufacturing Company.
e. Potter-Roemer; Div. of Smith Industries, Inc.

2. Fire-Protection Cabinets:

a. J.L. Industries, Inc.
b. Larsen's Manufacturing Company.
c. Potter-Roemer; Div. of Smith Industries, Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

1. Sheet: ASTM B 209 (ASTM B 209M).

2.3 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.

B. Multipurpose Dry-Chemical Type: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, in enameled-steel container.

2.4 FIRE-PROTECTION CABINETS

A. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.

1. Cabinet Metal: Aluminum sheet.

2. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material. Provide factory-drilled mounting holes.

B. Cabinet Type: Suitable for the following:

1. Fire extinguisher.

C. Cabinet Mounting: Suitable for the following mounting conditions as scheduled or shown on drawings

1. Semirecessed: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated.

D. Cabinet Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

1. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

a. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

E. Cabinet Trim Material: Manufacturer's standard, as follows:

1. Aluminum sheet.

F. Door Material: Manufacturer's standard, as follows:

1. Aluminum sheet.

G. Glazing: Impact resistant as standard with manufacturer.

1. Glass: Clear float glass, ASTM C 1036, Type I, Class 1, Quality q3, 1.5 mm, single strength.

H. Door Style: Manufacturer's standard design, as follows:

1. Vertical duo panel with frame. Lockable with pressure release latch.

I. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.

1. Provide minimum 1/2-inch- (13-mm-) thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.
2. Provide inside latch and lock that releases under pressure

J. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

2.5 ACCESSORIES

A. Door Locks: Provide cylinder lock, with all cabinets keyed alike.

B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.
   1. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.
      a. Application Process: Vinyl letters.
      b. Lettering Color: Red.
      c. Orientation: Vertical.

C. Mounting Brackets: For kitchen application provide Manufacturer's standard galvanized steel, bracket designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish. Red color unless otherwise indicated.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Cabinet and Door Finishes: Provide manufacturer's standard baked-enamel paint for Interior of cabinets and doors.

2.7 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets are to be installed.

C. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing fire-protection specialties.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
2. Fasten cabinets to structure, square and plumb.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 104413

SECTION 105500 - POSTAL SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. mailboxes – Rear loading in configurations as shown

B. Related Sections include the following:

1. Division 6 Section “Interior Architectural Woodwork” .

1.3 SUBMITTALS

A. Product Data: For each type of postal specialty specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

1. Provide manufacturer's certification that equipment proposed complies with USPS regulations and has been approved by the Postmaster General.

B. Shop Drawings: For each type of postal specialty specified. Show details of fabrication and installation. Include plans, elevations, sections, and attachments to other work.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and finishes of exposed materials and accessories available for each type of postal specialty indicated.

D. Samples for Verification: Full-size units of each type of exposed color and finish required for each type of postal specialty specified. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with USPS requirements for construction and installation of units

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Mailboxes

   a. American Eagle Mailboxes.
   b. American Postal Manufacturing Co.; Division of Postal Products Unlimited, Inc.
   c. Auth-Florence Manufacturing; a Florence company.
   d. Bommer Industries, Inc.
   e. Jensen Industries.
   f. Salsbury Industries.
   g. Security Manufacturing Corporation.

2.2 METALS

A. Aluminum: Alloy and temper best suited for the intended use and finish indicated.

1. Plate and Sheet: ASTM B 209 (ASTM B 209M), mill finish, where not exposed.
2. Extruded Bars and Shapes: ASTM B 221 (ASTM B 221M).

B. Steel: Cold-rolled steel sheet or plate, zinc-coated by electrodeposition, galvanized, or conversion coated for application of manufacturer's standard factory-applied, baked-enamel finish.

2.3 MAILBOXES

A. General: Provide vertical-style mailboxes complying with USPS Publication 17 in size and with features indicated.

1. Design Standard: Florence 1700 Series

B. Compartment Doors and Frames: Manufacturer's standard ganged and nested units with cardholder for tenant's identification behind each box. Construct doors with concealed, full-length, flush hinges and with slots to receive tenants' names and numbers. Fabricate doors and frames from extruded aluminum.

1. Number Identification: As shown or, if not shown, as selected by Architect from manufacturer's standards.
2. Locking: A 5-pin tumbler, cylinder lock capable of at least 1000 key changes, with 2 keys for each box door. Key each box differently and deliver keys to Owner with a record of each corresponding lock and key number.

C. Concealed Components and Wall Receptacles: Manufacturer's standard aluminum or steel sheet construction.

D. Directory: Manufacturer's standard directory unit in size and location as indicated and of same materials and finish as box frames, unless otherwise indicated.

E. Aluminum Finish: Finish exposed-to-view surfaces as follows:

1. Satin aluminum, clear anodized.

F. Steel Finish: Manufacturer's standard baked-enamel finish in color selected by Architect from manufacturer's full range of colors.

2.4 METAL FINISHES

A. Exposed Aluminum Finish: Manufacturer's standard matching the following BHMA finish code number, complying with ANSI/BHMA A156.18:

1. Satin Aluminum, Clear Anodized: BHMA Finish Code No. 628.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine mailroom areas and conditions for compliance with clearances and roughing-in requirements affecting installation of postal specialties. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. In addition to requirements of these Specifications, comply with manufacturer's written instructions and recommendations for preparing substrates, installing anchors, and applying postal specialty units.

3.3 INSTALLATION

A. Install postal specialties level and plumb, according to manufacturer's written instructions, roughing-in drawings, original design, and referenced standards.

1. Final acceptance depends on compliance with USPS requirements.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure postal specialties are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 105500

SECTION 107315 - EXTERIOR SUN CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Provide fixed Custom Sunshades as shown on the drawings, as specified, and as needed for a complete and proper installation.

B. The drawings show the extent of the work, the dimensioned profile and depth of the sunshade to be provided.

C. Related work specified elsewhere:

1. Division 5 Section - Metal Fabrication
2. Division 8 Section - Alumninum Entrances and Storefront
3. Division 8 Sections - Aluminum Curtainwall, Aluminum Windows and Storefront

1.03 SUBMITTALS

A. Product Data: Submit specifications, data, and installation, instructions from the manufacturer of the Sunshades.

B. Submit shop drawings for the system. Show anchorage, details and connections for all the component parts.

1. Drawings shall include elevations, sections and specific details for each unit, condition.

C. Samples: Submit one sample minimum 24" long of each material to be utilized at each Sunshade with appropriate finish.

D. Warranty: Provide written warranty to the owner that all screen products will be free of defective materials or workmanship for a period of one year from date of installation.

E. Quality Assurance:

1. Single subcontract responsibility: Subcontract the work to a single firm that has had not less than ten years experience in the design and manufacturing of work similar to that shown and required. Sub-contracting of the fabrication of the sunshades to a shop other than the vendor who is contracted for the material, is not acceptable.

2. Performance requirements: Design sunshades to accommodate local requirements for snow and wind loading. Provide vendors calculations for the design being supplied. Calculation should be signed and sealed by an Engineer registered in the state where the project is located. . Analysis of Blade Deflection to be limited to L/120, ¾", or as required by code.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Manufacturers offering products that may incorporated into the work, include, but are not limited to, the following:

Construction Specialties, Inc
Kawneer Inc
YKK AP America

2.02 MATERIALS

A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5.

B. Fasteners: Fasteners shall be aluminum or stainless steel. Provide types, gauges and lengths to suit unit installation conditions.

C. Anchors and Inserts: Use non-Ferrous metal or hot dip galvanized anchors and inserts for installation and elsewhere as required for corrosion resistance. Use stainless steel or lead expansion bolt devices for drill-in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.03 FABRICATION, GENERAL

A. Provide fixed Sunshades and accessories of design, material, sizes, depth, arrangement, and thickness as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.

B. Include supports, anchorage, and accessories required for complete assembly

2.04 SUNSHADE CONSTRUCTION

A. Components: All blades and outrigger components shall be 6063-T5 aluminum alloy.
   1. Outriggers to be mounted to wall using Aluminum "T" brackets bolted to the wall condition. Aluminum "T" brackets to be supplied by Sunshade manufacturer.
   2. Outriggers mounted to aluminum glazing members to be anchored into framing members
   3. Outriggers shall be flat aluminum members as standard with manufacturer with wedge profile.
   4. Blades shall be tubular extruded style. Blades shall be factory assembled to 1/4" outrigger plates using stainless steel, type F, thread cutting screws through internal screw slots in blades.

Welding is not acceptable, blades must be removable in case of damage. Fasteners to be hex head..

5 Fascia to be clipped to the outriggers.

6 Design Standard: Kawneer TriFab Sunshade Wedge Shaped outriggers with angular fascia and circular louvers

2.05 ALUMINUM FINISH

A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory after products assembly. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces which will be visible after completing finishing process.

1. Provide color as indicated or, if not otherwise indicated, as selected by architect from manufacturers standard Kynar 500 colors.

B. Fluorocarbon Coating: Inhibitive thermo-cured primer, 0.2 mil minimum dry film thickness, and thermo-cured fluorocarbon coating containing "Kynar 500" resin, 1.0 mil minimum dry film thickness.

Furnish manufacturers twenty (20) year limited warranty against failure of the Kynar 500 finish.

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PART 3 - EXECUTION

3.01 INSPECTION

A. Examine openings to receive the work. Do not proceed until any unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of the work.

B. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure.

C. Anchor Sunscreen to building substructure as indicated on architectural drawings.

D. Erection Tolerances:

1. Variation from level: +/- 1/8" maximum in any column to column space or 20'-0" runs, non-cumulative.

2. Offsets in end-to-end or edge-to-edge alignment of consecutive members 1/32".

F. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly as directed.

G. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.

H. Set units level, plumb and true to line, with uniform joints

.

END OF SECTION

SECTION 116823 - SAND VOLLEYBALL COURT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Volleyball net uprights
   2. Sand Court.

B. Related Sections include the following:
   1. Division 32 Sections for Earthwork and Landscaping
   2. Division 32 Section for Concrete Edging

1.3 DEFINITIONS

A. FIVB: International Volleyball Federation (Federation Internationale de Volleyball).

B. USAV: USA Volleyball.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

   1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.

B. Shop Drawings: For volleyball equipment. Include plans, elevations, sections, details, attachments to other work, and the following:

   1. Method of field assembly for removable equipment, connections, installation details, mountings

C. Samples for Initial Selection: For each type of equipment indicated.

D. Samples for Verification: For the following products:
   1. **Volleyball** Post Standard: Full-size unit **with net tensioner**.

E. Product Certificates: For each type of volleyball equipment, signed by product manufacturer.

F. Operation and Maintenance Data: For volleyball equipment to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: **Fabricator of products** or workers trained by manufacturer.

B. Source Limitations: Obtain each type of volleyball equipment through one source from a single manufacturer.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify position and elevation and layout for volleyball equipment.

1.7 COORDINATION

A. Coordinate installation of receivers or ground set sleeves with court layout and game lines and markers.

B. Coordinate layout and installation of overhead-supported volleyball equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of volleyball equipment that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

2. Warranty Period: **Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extruded Bars, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
2. Cast Aluminum: ASTM B 179.
3. Flat Sheet: ASTM B 209 (ASTM B 209M).

B. Steel: Comply with the following:

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Tubing: ASTM A 500 or ASTM A 513, cold formed.
3. Steel Sheet: ASTM A 1011/A 1011M.

C. Anchors, Fasteners, Fittings and Hardware: Manufacturer's standard corrosion-resistant or noncorrodible units; concealed**; tamperproof, vandal- and theft-resistant design**.

2.2 VOLLEYBALL EQUIPMENT – EXTERIOR COURT SYSTEM

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AALCO Manufacturing.
2. ADP Lemco Inc.
3. American Athletic, Inc.
4. Arizona Courtlines, Inc.
5. Bison Inc.
6. Douglas Industries, Inc.
7. Draper Inc.
8. Jaypro Sports, LLC.
9. L. A. Steelcraft.
10. Performance Sports Systems.
11. Porter Athletic Equipment Company.
12. P. W. Athletic Mfg. Co.
13. Schelde North America.
14. Sports Imports.

B. General: Provide equipment complying with requirements in **FIVB's "Official Volleyball Rules OR "USA Volleyball Rule Book**."

C. Post Standards: paired volleyball post standards. Fabricated from **manufacturer's standard metal** pipe or tubing, Finished with manufacturer's standard factory-applied, baked powder-coating finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness or plated metal finish.

1. Nominal Pipe or Tubing Diameter: **4-inch (102-mm)** OD at base.

2.3 INORGANIC LOOSE-FILL SURFACE

A. Fill for volleyball court:
A minimum of 40cm (16 inches) of soft sand is required throughout the entire Free Zone (18m x 26m - the court is 8m x 8m) :

B. Sand

Name	Particle Size	Spec (% Retained on Sieves)
Fine gravel	2.0 mm	0%
Very Course sand	1.0 mm - 2.0 mm	0%-6%
Coarse sand	0.5 mm - 1.0 mm	min of 80%
Medium sand	0.25 mm - 0.5 mm	max of 92%
Fine sand	0.15 mm - 0.25 mm	7%- 18%
Very fine sand	0.05 mm - 0.15 mm	not greater than 2.0%
Silt and Clay	below 0.05 mm	not greater than 0.15%

C. The sand must also be free of any organic material.

D. Particle Shape: The recommended sand requirements for court installations have the following: physical properties:
   - be naturally weathered;
   - be sub angular/rounded;
   - not be acquired from a crushed rock source.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, and other conditions affecting performance.

1. Verify critical dimensions.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written installation instructions **and competition rules indicated for each type of volleyball equipment**. Complete equipment field assembly, where required.

B. Fixed Volleyball Equipment: Assemble in place to verify that equipment and components are complete .

3.3 CLEANING

A. After completing volleyball equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.

B. Replace volleyball equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 116823

SECTION 122413 - ROLLER SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes roller shades for manual operation installed at all exterior Office Windows, Meeting rooms windows, Kitchen/Lounge Windows Lounge Windows windows and Group Study windows.

B. Fabric as selected with openness factor indicated of Green Guard Certified material, blackout shades where shown

C. Related Sections include the following:
   1. Division 6 Section "Miscellaneous Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other Work, operational clearances, and relationship to adjoining work.

C. Samples for Initial Selection: For each colored component of each type of roller shade indicated.

   1. Include similar Samples of accessories involving color selection.

   2. Fabric samples minimum 18 inches square

D. Window Treatment Schedule: Include roller shades in schedule using same room designations indicated on Drawings. Indicated size of shade with no individual shade section exceeding 60 inch width.

E. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:

   1. Methods for maintaining roller shades and finishes.
   2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
   3. Operating hardware.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed installation of roller shades similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: Passes NFPA 701.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Draper Shade & Screen Co., Inc.
2. MechoShade Systems, Inc.
3. Skyco
4. Mariak
5. VIMCO.

2.2 ROLLER SHADES

A. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with hook-and-loop strip or removbable spline in channel for attaching shade material. Provide capacity for one roller shade band per roller, unless otherwise indicated.

B. Direction of Roll: Regular, from back of roller.

C. Mounting Brackets: Galvanized or zinc-plated steel.

D. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide bottom bar with concealed weight bar concealed, by pocket of shade material, internal-type as required for smooth, properly balanced shade operation.

E. Shade Operation: Manual; with continuous loop bead chain, clutch, and cord tensioner and bracket lift operator.

1. Position of Clutch Operator: Right side of unit unless otherwise indicated or required for operation.
2. Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
3. Lift Assist Mechanism: Manufacturer's standard spring assist for balancing roller shade weight and lifting heavy roller shades.
4. Loop Length: Full length of roller shade.
5. Bead Chain: Stainless steel.
6. Cord Tensioner Mounting: Sill or floor.
7. Operating Function: Stop and hold shade at any position in ascending or descending travel.

F. Shade Band Material: PVC-coated polyester.

1. Fabric Width: 84 inches (2130 mm).
2. Pattern: One (1) percent openness factor
3. Colors: As selected by Architect from manufacturer's full range of Green Guard Certified products
4. Bottom Hem: Straight.

G. Mounting: Wall extension brackets, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

2.3 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lifting Mechanism: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Shade Units Installed Outside Jambs: Width and length from measured openings, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
2. Areas free of mullions shall be divided equally between partitions as directed by Architect.

D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting roller, and operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: Not fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

F. Finish: For metal components exposed to view, brushed aluminum finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION

SECTION 124813 - FLOOR MATS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Surface-type floor mats of the following type:
      a. Rubber-entrance mats with carpet inserts.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of floor mat specified, including manufacturer's specifications and installation instructions, details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. Shop drawings showing layout and types of floor mat, full-scale sections of typical installations, details of patterns or designs, anchors, and accessories.

D. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual sections of floor mat materials, showing full range of colors, textures, finishes, and patterns available, for type of floor mat indicated.

E. Samples for verification purposes in form of 12-inch-square assembled section of floor mat with selected tread surface showing each type of finish and color of exposed floor mat and accessories required. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

F. Maintenance data in the form of manufacturer's printed instructions for cleaning and maintaining floor mats.

1.4 PROJECT CONDITIONS

A. Field Measurements: Check actual framed openings for mats by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid a delay of the Work.

   1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabrication without field measurements. Coordinate floor construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain floor mats from one source of a single manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide colors, patterns, and profiles of materials. Where not indicated, provide colors, patterns, and profiles selected by Architect from manufacturer's standards.

B. One-Piece Rubber Mats: Compounded rubber mats; square edged except beveled where indicated for surface application (no recess in floor to receive mat).

1. Mat Style: Solid sheet (no perforations).
2. Thickness: 3/8 inch.
3. Field Surface: Low-rib narrow-wale corrugated.
4. Bottom Surface: Flat base.
5. Tread Surface: Fusion-bonded carpet insert of 1/4-inch-high, 28 oz. per sq. yd. level-cut DuPont Antron III nylon filament.
6. Design Standards:
   a. Products: RC Musson Track Strip & Vinyl Mat or Johnsonite “Floor Keeper”.
   b. Matting Color: Dark Grey.
   c. Carpet: Color as selected by Architect.

   The use of a Design Standard is to establish a level of quality and appearance for the finished work and is not to be construed as a restraint of trade or a limit of competition.

C. Edge Angles: Where mats abut storefront or at exposed edges provide inverted edge angles of extruded aluminum: ASTM B 221 (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.

2.2 FABRICATION

A. Shop-fabricate units of floor mat work to greatest extent possible in sizes as indicated. Where not indicated otherwise, provide single unit for each mat installation, but do not exceed manufacturer's maximum size recommendation. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition mats to interior temperatures prior to installation.

B. Unroll material and allow to relax fully prior to installation, to eliminate puckers, and ridges in the initial set of the product.

3.2 INSTALLATION

A. Install surface-type units to comply with manufacturer's instructions at locations indicated and coordinated with entrance locations and traffic patterns.

B. Install inverted edge angles where mats abut storefront to act as continuous retention clips to prevent curling or displacement of mat. Set angles a maximum of ¾ inch above substrate, and anchor to storefront at 8 inches o.c.

C. Where edge angle creates a raised edge and tripping hazard, provide glue down installation or transition edging to create a smooth transition to surrounding floor surfaces.

3.3 PROTECTION

A. Defer installation of floor mats until time of Substantial Completion for Project.

END OF SECTION 124813

SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Benches
   2. Tables
   3. Canopies
   4. Gas Grill
   5. Fire Ring

B. Related Sections include the following:

   1. Division 03 Section "Cast-in-Place Concrete" for **installation of anchor bolts cast** in concrete footings.
   2. Division 31 Section "Earth Moving" for excavation for installation of concrete footings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

   1. Size: Not less than 6-inch- (152-mm-) long linear components and 4-inch- (102-mm-) square sheet components.

C. Maintenance Data: For site furnishings to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain **each type of** site furnishing(s) through one source from a single manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:

1. Rolled or Cold-Finished Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).
2. Extruded Bars, Rods, Wire, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Structural Pipe and Tube: ASTM B 429.
4. Sheet and Plate: ASTM B 209 (ASTM B 209M).
5. Castings: ASTM B 26/B 26M.

B. Stainless Steel: Type 316 Free of surface blemishes and complying with the following:

1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
2. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312M.
3. Tubing: ASTM A 554.

C. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53, or electric-resistance-welded pipe complying with ASTM A 135.
3. Tubing: Cold-formed steel tubing complying with ASTM A 500.
4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500; zinc coated internally and externally.
5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.

D. Anchors, Fasteners, Fittings, and Hardware: **Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials**; commercial quality**,**

E. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107; recommended in writing by manufacturer, for exterior applications.

F. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

2.3 BENCHES, TABLES, SHADES

A. Bench: Provide the following as indicated on drawings:

Metal Bench
Product: tubular steel frame with welded wire panels
Plastisol coated
Furnish all mounting hardware.
Model: 3 SEAT Backless benches - Plexus
Color: As Selected by Architect:
Mounting Type: Permanent extended leg mounting system.
Manufacturer: Landscape Forms

B. Picnic Table: Provide the following as indicated on drawings:

<u>Picnic Table</u>
Product: tubular steel frame with welded wire panels
Plastisol coated

Furnish all mounting hardware.
Model: Steelhead perforated Carousel with 4 seats
Color: As Selected by Architect:
Manufacturer: Landscape Forms

C. Shade: for center mounting through table

Product: solstice

Model: Altair

Size: 91 x 86

Manufacturer: Landscape Forms

2.4 GAS GRILL

A. Natural Gas fired unit – Built-in unit Stainless steel cabinet

1. Nominal 83 inches long x 2'-4 deep with stainless steel lid and shelves

983 square inch cooking grid (48" x 24" Grid Dimensions)
Four 20,000 BTU 304 Stainless Steel Burners (Total 80,000 BTUs)
Direct (24" x 24") and Indirect (24" x 24") Cooking Surfaces
Electronic Igniter
Rust Free Stainless Steel and Aluminum Construction
Stainless Steel flavor bars reduce flare-up and provide even heat distribution.
Stainless steel ash tray allows for convenient removal of ashes from charcoal and wood

B. Design Standard: Vidalia Model 983

2.5 FIRE PIT

A. Stainless Steel Fire Ring 48 inch dia. Triple element ring fabricated from stainless steel with ports staggered at approximately 3 inches o.c.

1. ½ inch NPT
2. Sized to 650,000 BtUh

B. Custom Size Burner Pan: Size to match cast in place fire pit base, Fabricated from 16 gauge Powder coated steel with perforations for service supply and drainage.

C. Stainless Steel Valve Box: Fabricated from 16 ga stainless steel to enclose the electronic ignition system and interface with remote control system.

D. FIRE GLASS FILL - Provide rough cast fire glass aggregate in color as selected by Architect to infill bottom of fire pit and cover burner ring a minimum of 1 inch at outside edge of ring and 2 inches at center of ring.

1. Provide fire glass in aggregate size of 1.5 to 2 inches in nominal dimension.

E. Manufacturer: Flame Creations, Snellville, GA.

2.6 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

C. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 STEEL AND GALVANIZED STEEL FINISHES

A. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and **securely anchored** at locations indicated on Drawings.

3.3 CLEANING

A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION 129300

SECTION 142400 - HYDRAULIC ELEVATOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes holeless hydraulic passenger elevator
   1. Extensions, attachment brackets, subsill angles and other hardware as required for a complete installation are required as work of this Section.
   2. Provide railings and other code required protections where manufacturers standard hoistway dimension is less than rough hoistway dimensions shown on drawings.
   3. Battery powered lowering and provisions for standby power operation.
   4. All communication, control and security system wiring to provide a complete installation for Owner's use.
   5. Diagnostic unit for Analytical interface to equipment provided to Owner for continuing maintenance operations.

B. Drawings indicated a generic selection for elevator. Modifications to the pit or shaft dimensions must be coordinated without additional expense to the Owner.

C. Related Sections include the following:

   1. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
   2. Division 05 Section "Structural Steel Framing"

      a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.

   3. Division 05 Section "Metal Fabrications" for the following:

      a. Attachment plates and angle brackets for supporting guide-rail brackets.
      b. Hoist beams.
      c. Structural-steel shapes for subsills.
      d. Pit ladders.
   4. Division 09 Section for Carpet floor finish.
   5. Division 26 Sections for electrical service for elevators to and including disconnect switches at machine room door.
   6. Division 27 Section "Communications Horizontal Cabling" for telephone service for elevators.
   7. Division 28 Section "Fire Detection and Alarm" for smoke detectors in elevator lobbies to initiate emergency recall operation and for connection to elevator controllers.
   8. Division 22 Section for sump pumps in elevator pits.

1.3 DEFINITIONS

A. Definitions in ASME A17.1 apply to work of this Section. Including Seismic switches where applicable and other protective devices.

B. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.4 SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:

1. Car enclosures and hoistway entrances.
2. Operation, control, and signal systems.

B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

E. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

F. Qualification Data: For Installer.

G. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

H. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

I. Warranty: Special warranty specified in this Section.

J. Continuing Maintenance Proposal: Service agreement specified in this Section.

K. Diagnostic Unit for elevator operations: Provide unit as required to communicate with elevator controls and operation system in continuing maintenance operations beyond the warranty period.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain elevators through one source from a single manufacturer.

1. Provide major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.

C. Regulatory Requirements: Comply with ASME A17.1 and elevator design requirements for earthquake loads in ASCE 7.

1. Effective peak velocity acceleration (Av) for Project's location is greater than or equal to 0.20 (seismic risk zones 3 and 4).
2. Design earthquake spectral response acceleration: F_s = 1.392; $F_{I =}$ 0.581; F_{DS} = 0.928; F_{DI} = 0.581.
3. Project's seismic design category: “D”.
4. Elevator importance factor is 1.0.

D. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." and 407 in ICC A117.1.

E. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.

B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.7 COORDINATION

A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.

B. Coordinate sequence of elevator installation with other work to avoid delaying the Work.

C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, 7-day-per-week emergency callback service.

a. Response Time: Two hours or less.

B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal, from Installer to Owner, in the form of a standard three-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options. This proposal, if accepted by the Owner, shall be transferable to a different Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ThyssenKrupp Elevator.
2. Schindler

2.2 SYSTEMS AND COMPONENTS

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.

B. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide the following:

1. Submersible pump, with submersible squirrel-cage induction motor, suspended inside oil tank from vibration isolation mounts.
2. Provide motor with solid-state starting.
3. Provide variable-voltage variable-frequency motor control.

C. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.

D. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.
   1. Casing for Underground Piping: PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.

E. Hydraulic Fluid: Elevator manufacturer's standard fire-resistant fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.

F. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.

G. Car Frame and Platform: Welded steel units.

H. Guides: Provide either roller guides or sliding guides at top and bottom of car and counterweight frames. If sliding guides are used, provide guide-rail lubricators or polymer-coated, nonlubricated guides.

2.3 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation system for each elevator as required to provide type of operation system indicated.

B. Single-Car Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
   1. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.

   2. Standby Power Operation: Provision will be included to connect to emergency generator for standby power . On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at **main lobby or fire command station**. Manual operation causes automatic operation to cease.
   3. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls **and predetermined weight** can be adjusted.

C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

   1. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.4 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

2.5 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

E. Stainless-Steel Bars: ASTM A 276, Type 304.

F. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

G. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

H. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications and Type BKV for panel backing.

2.6 CAR ENCLOSURES

A. General: Provide steel-framed car enclosures with nonremovable wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
2. Provide finished car including materials and finishes specified below.

B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:

1. Subfloor: Underlayment grade, exterior plywood, 5/8-inch (16-mm) nominal thickness.
2. Floor Finish: Specified in a Division 09 Section.
3. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to manufacturer's standard honeycomb core with plastic-laminate panel backing and manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by Architect from plastic-laminate manufacturer's full range.
4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
6. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
7. Sight Guards: Provide sight guards on car doors.
8. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.

9. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
10. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.7 HOISTWAY ENTRANCES

A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.

1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.

B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:

1. Stainless-Steel Frames: Formed from stainless-steel sheet.
2. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
3. Sight Guards: Provide sight guards on doors matching door edges.
4. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

2.8 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers or LEDs.

B. Swing-Return Car Control Stations: Provide car control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.

1. Mark buttons and switches with standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section "Fire Detection and Alarm."

E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.

1. Include travel direction arrows if not provided in car control station.

F. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator.

G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
1. Units mounted in both car door jambs; may be used only for single elevators.

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

I. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above[each] hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.

1. Integrate ground-floor hall lanterns with hall position indicators.

J. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

K. Standby Power Elevator Selector Switches: Unless only required for high-rise construction, Provide switches, as required by ASME A17.1, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. **For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.**

2.9 ELEVATORS

A. Elevator Description:

1. Elevator .
2. Type: Holeless, beside-the-car, dual cylinder.
3. Rated Load: 4500 lb
4. Rated Speed: 125 fpm .
5. Operation System: Single automatic operation.
6. Travel 24-0
7. Stops 3 floors
8. Auxiliary Operations:

a. Automatic dispatching of loaded car.

9. Car Enclosures:

a. Inside Width: 80 inches (2032 mm) from side wall to side wall.
b. Inside Depth: 65 inches (1651 mm) from back wall to front wall (return panels).
c. Inside Height: 96 inches to underside of ceiling.

d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
e. Car Fixtures: Satin stainless steel, No. 4 finish.
f. Side and Rear Wall Panels: Plastic laminate.
g. Reveals: Satin stainless steel, No. 4 finish.
h. Door Faces (Interior): Satin stainless steel, No. 4 finish.
i. Door Sills: Aluminum, mill finish.
j. Ceiling: Satin stainless steel, No. 4 finish.
k. Handrails: 1-1/2 inches (38 mm) round satin stainless steel, No. 4 finish, at sides and rear of car.
l. Floor prepared to receive carpet
m. Floor Thickness, Including Setting Materials: 5/8 above plywood subfloor.

10. Hoistway Entrances:

a. Width: 42 inches (1067 mm).
b. Height: 84 inches
c. Type: Single-speed center opening.
d. Fire-Protection Rating: 1-1/2 hours with 30-minute temperature rise of 450 deg F (250 deg C).
e. Frames at all Floors: Satin stainless steel, No. 4 finish.
f. Doors at all Floors: Satin stainless steel, No. 4 finish.
g. Sills at all Floors: Aluminum, mill finish.

11. Hall Fixtures at all Floors: Satin stainless steel, No. 4 finish.
12. Additional Requirements:

a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
b. Provide blanket hooks and one complete set of full-height protective blankets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain

alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.

D. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.

E. Lubricate operating parts of systems as recommended by manufacturers.

F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

G. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and direction of travel.

H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

I. Locate hall signal equipment for elevators as follows, unless otherwise indicated:

1. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

C. Provide to Owner, electronic diagnostic equipment required to communicate with Equipment when troubleshooting malfunctions.

3.4 PROTECTION

A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.

4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s). Refer to Division 01 Section "Demonstration and Training."

B. Check operation of elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

C. Check operation of elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 142400

P R O J E C T M A N U A L

WEBER STATE UNIVERSITY

RESIDENTIAL LIFE PHASE 2

BUILDING 2

VOLUME TWO
DIVISIONS TWENTY-ONE – THIRTY THREE

CONSTRUCTION DOCUMENTS

MHTN PROJECT NO 2010543.00
DFCM PROJECT NO 10176810

14 APRIL 2011

MHTN
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RESIDENTIAL LIFE BUILDING - Phase 2 Building 2
WEBER STATE UNIVERSITY

Table of Contents

CONSTRUCTION DOCUMENTS

14 April 2011

MHTN PROJECT NO 2010543.00
DFCM PROJECT NO 10176810

VOLUME TWO

Division	Section Title	Pages
SPECIFICATIONS GROUP		
	Facility Services Subgroup	
DIVISION 21 – FIRE SUPPRESSION		
211000	FIRE PROTECTION	20
DIVISION 22 – PLUMBING		
221113	FACILITY WATER DISTRIBUTION PIPING	10
221313	FACILITY SANITARY SEWERS	12
221410	PLUMBING PIPING	7
221411	DISINFECTING WATER SUPPLY SYSTEM	5
221430	PLUMBING SPECIALITES	14
224440	PLUMBING FIXTURES	10
224450	PLUMBING EQUIPMENT	7
224460	SPECIAL PLUMBING EQUIPMENT SYSTEMS	4
DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING		
230500	BASIC MECHANICAL REQUIREMENTS	18
230529	BASIC MECHANICAL MATERIALS AND METHODS	30
230540	MECHANICAL SOUND AND VIBRATION CONTROL	22
230548	MECHANICAL SEISMIC CONTROL	6
230593	TESTING, ADJUSTING AND BALANCING	6
230700	MECHANICAL INSULATION	10
230800	COMMISSIONING OF HVAC	11
230810	VARIABLE FREQUENCY DRIVE	7
230900	ELECTRONIC CONTROLS	37
231123	NATURAL GAS SYSTEM	8
232113	HVAC PIPING AND SPECIALTIES	18
232123	HVAC PUMPS	5
232500	HVAC WATER TREATMENT	8
233300	DUCTWORK AND ACCESSORIES	17
233400	AIR HANDLING FANS	5
233713	AIR INLETS AND OUTLETS	4

234100	AIR CLEANING	3
235100	BREECHINGS, CHIMNEYS, STACKS AND FLUES	4
235200	BOILERS	5
235550	SOLAR ENERGY SYSTEMS	13
235700	HEAT TRANSFER	4
236400	REFRIGERATION	9
237400	AIR HANDLING SYSTEMS ON ROOF	8
238146	HEAT PUMPS	7

DIVISION 26 ELECTRICAL -

260500	COMMON WORK RESULTS FOR ELECTRICAL	9
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES	7
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS	7
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	5
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS	12
260536	CABLE TRAYS FOR ELECTRICAL SYSTEMS	5
260543	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS	14
260548	VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS	8
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS	9
260573	OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY	7
260574	ELECTRICAL TESTING	2
260800	ELECTRICAL SYSTEMS COMMISSIONING	8
260923	LIGHTING CONTROL DEVICES	5
262413	SWITCHBOARDS	10
262416	PANELBOARDS	9
262713	ELECTRICITY METERING	5
262726	WIRING DEVICES	7
262813	FUSES	3
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS	8
263600	TRANSFER SWITCHES	6
264313	SURGE PROTECTIVE DEVICES (SPDs)	7
265100	INTERIOR LIGHTING	8
265600	EXTERIOR LIGHTING	8

DIVISION 27 - ELECTRICAL SAFETY AND SECURITY

270528	PATHWAYS FOR COMMUNICATIONS SYSTEMS	6

DIVISION 28 - ELECTRICAL SAFETY AND SECURITY

283111	DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM	22

Site and Infrastructure Subgroup

DIVISION 31 - EARTHWORK

310700	GENERAL SITE CONSTRUCTION REQUIREMENTS	4
311000	SITE CLEARING	6
312000	EARTH MOVING	14
312319	DEWATERING	6
315000	EXCAVATION SUPPORT AND PROTECTION	4

DIVISION 32 - EXTERIOR IMPROVEMENTS

321216	ASPHALT PAVING	10
321313	CONCRETE PAVING	16
321373	CONCRETE PAVING JOINT SEALANTS	8
321400	UNIT PAVAERS	5
321443	POROUS UNIT PAVING	5
322000	SITE SIGNAGE	4
323119	ORNAMENTAL METAL FENCES AND GATES	7
323230	BOULDERS	3
328400	IRRIGATION SYSTEMS	21
328402	DRIP IRRIGATION SYSTEMS	12
329200	LAWNS AND GRASSES	9
329300	LANDSCAPE PLANTING	15

DIVISION 33 - UTILITIES

330500	COMMON WORK RESULTS FOR UTILITIES	12
334110	STORM UTILITY DRAINAGE PIPING	18
334600	SUBDRAINAGE	10

APPENDIX

GSH Geotechnical Report December 15, 2010 46

SECTION 211000 - FIRE PROTECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Connections and Fees.

B. Firelines, Extensions as shown on Drawings.

C. System Design Requirements per Jurisdictional Authorities.

D. Underground Exterior Piping as shown on Drawings.

E. Interior and Exterior above Ground Piping.

F. Sprinkler System.

G. Standpipe System.

H. Fire Department Connections.

I. All Alarms, Switches and Required Wiring.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

C. The 211000 Contractor shall furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete sprinkler system ready for operation in accordance with the requirements of the authority having jurisdiction. The purpose of the furnished specifications and associated drawings is to convey to the Contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust and make operable. The Contractor shall examine all existing physical conditions which may be material to the performance of his work. No extra payments will be allowed to the Contractor as a result of extra work made necessary by his failure to do so. Any case of discrepancy or lack of clarity shall be promptly identified to the Owner's Representative and Engineer for clarification.

1.3 RELATED SECTIONS

A. Section 012300 - Alternates.

B. Section 230529 - Basic Mechanical Materials and Methods.

C. Section 230540 - Mechanical Sound and Vibration Control.

D. Section 221410 - Plumbing Piping: Copper water piping.

E. Section 221411 - Disinfecting Water Supply System.

F. Section 221430 - Plumbing Specialties: Pressure gauges, air gap fittings, pressure relief valves.

1.4 FIRE LINES

A. The work of this section shall start at the water service entrance termination flange installed inside the building and above the floor by the site utilities contractor.

1.5 CONNECTIONS AND FEES

A. System development charges and or similar charges, that in principle allow the right to obtain the services from the utility will be arranged and paid for by the Site Utilities Contractor. Division 211000 Contractor shall contact all jurisdiction authorities to verify fee requirement.

B. Tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities Contractor.

C. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the Site Utilities Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the 211000 Contractor.

D. Be responsible for all pads, vaults, manholes, manhole covers, valve enclosures, valves, services boxes, and required material, all in conformance with requirements of the serving utility company.

E. Contractor shall coordinate with other trades all interface piping and types of connections to be provided for interface.

F. Permit fees shall be provided in the base bid. The 211000 Contractor shall furnish the Owner with a copy of all official documents and written correspondence associated with permits.

1.6 DEFINITIONS

A. The following are references with definition acronyms used in this section:

1. U.L. - Underwriters Laboratory Listed for Fire Protection Systems.
2. F.M. – FM Global or Factory Mutual Research.
3. IRI - Industrial Risk Insurors (aka: F.I.A. Factory Insurance Association.)
4. NFPA - National Fire Protection Association.
5. Jurisdictional Agencies:

   a. Building Department.
   b. Fire Department or Fire Prevention Bureau or Marshal.

c. Insurance Agency, Carrier, and/or Underwriter as defined in Section 1.7.

6. Engineer refers to the consulting Mechanical Engineer of record.
7. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
8. Other definitions for fire protection systems are listed in NFPA 13.
9. Working Plans as used in this Section mean those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval of the authority having jurisdiction.
10. Review and Approval will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.7 SYSTEM DESIGN REQUIREMENTS

A. Sprinkler System Requirements:

1. Provide a freeze-protected sprinkler system using dry sprinkler heads or charged with U.S.P. glycerin or propylene glycol to protect vestibules, entry canopy, and similar areas subject to freezing.
2. Provide a wet pipe sprinkler system to protect all other areas of the building. Include protection of rubbish chutes, linen chutes, elevator shafts, kitchen exhaust ducts, mechanical rooms, and similar areas as required by code.
3. Sprinkler heads shall be centered in ceiling tiles in all finished areas.
4. Provide inspector test valve and piped drain at each riser.
5. Provide isolation valve on all main piping at each floor to isolate.

B. Standpipe System Requirements:

1. Provide Class I standpipe system of the automatic wet type as required by code and as approved by the jurisdictional authority.

   Locate Class I hose connections at each intermediate landing in every required stairway, at opening of horizontal exits, at entrance of exit passageways, at entrance of covered mall buildings, and on the roof at the top of each standpipe riser.

C. Occupancy hazard classifications shall be determined in accordance with NFPA 13 unless higher hazard classifications are indicated on the drawings or required by insurance underwriter or jurisdictional authority. Design for 0.12 GPM/Sq.Ft. minimum flow density for all light hazard occupancies.

D. Fire protection shall be designed and installed per NFPA 13 and NFPA 14 current published standards and local Jurisdictional Agency requirements. Where a conflict occurs the more stringent standard shall apply.

E. Verify requirements with Jurisdictional authorities, i.e.: Insurance Co. or Underwriter (when specified above), Fire Department or Marshal, or Building Department. Provide system complete, functional and acceptable to Jurisdictions without penalty of any type to the insurance premium rate. Division 211000 Contractor shall coordinate his work with all other sections of these specifications and drawings. No change order will be issued for lack of coordination or lack of verification of requirements of Jurisdictional Authorities.

F. System shall be hydraulically calculated per Jurisdictional Agency Standards.

G. All calculations shall include flow test results. Flow tests shall be performed by this Contractor and submitted to the Fire Department. Prior flow tests on file with jurisdictional agencies may be used in lieu of new flow tests only when previous test has been made within 3 months of project start date.

H. The system shall be designed to account for seasonal changes and for future degradation of the water supply system, using previous seasonal flow tests from the water utility to determine the expected range of pressure fluctuation at the project site.

I. Be responsible for accurate measurements, coordination with other trades, required offsets, scheduling, timely submittals, material delivery, job manning, and conformance to construction schedules.

J. Provide backflow protection in accordance with jurisdictional requirements. Provide back flow preventers of required types, and installed in an approved manner above or below grade as applicable. Backflow devices in pits or vaults below ground will not be acceptable unless the pit or vault is free draining, provided with a floor drain piped to atmosphere without the aid of mechanical pumps or devices. Outfall for drain must be installed in non flood and non submersible positions. Backflow devices above grade shall be protected with self regulating thermostat controlled heat cable, approved for fire service by the jurisdictional authority, and shall not be less than 15 watts/lineal foot installed with required pitch. Insulate with 2" fiber glass with all service jacket and cover with weatherproof aluminum protective jacket. Heat cable shall be as manufactured by Raychem "Auto Trace". Backflow preventer shall be as manufactured by "FEBCO" or "BEECO". Refer to Sections 230529 and 221430 for specifications for Heat Trace and Backflow Preventers. Verification as to acceptance by jurisdictional authority and fire insurance underwriter shall be the responsibility of this Contractor.

K. All areas shall be classified in accordance with NFPA 13 with respect to hazard classification and shall have automatic sprinkler systems designed for the appropriate classification.

L. Fire Protection Contractor shall furnish and install all alarm and supervisory switches or devices required for the automatic sprinkler system, installed so as to provide an electrically supervised system.

M. The number and location of fire department connections shall be coordinated with the Architect and local Fire Department. The fire department connections shall be piped directly into the building fire protection loop or standpipe system.

N. Each sprinkler riser control valve shall be equipped with a valve supervisory switch and a waterflow switch on piping down stream of the last control valve. Drain piping for each fire protection riser shall be sized and located to accommodate full flow from the main drain under normal system pressure.

O. When project is located within a seismic zone which is subject to earthquakes, sprinkler systems shall be protected per NFPA 13 to prevent breakage.

1.8 QUALITY ASSURANCE

A. The firm, company, corporation, or partnership producing and providing the material and labor of this Section shall have at least 3 years experience performing scope of work described and required by these Contract Documents.

B. Acceptable Fire Protection Contractors meeting the above requirements are as follows:

1. Delta Fire Protection, Salt Lake City, UT
2. Alta Fire Protection, Salt Lake City, UT
3. Fire Engineering Company, Salt Lake City, UT
4. Chaparral Fire Protection, Salt Lake City, UT
5. Firetrol Protection Systems, Salt Lake City, UT
6. Grinnell Fire Protection, Salt Lake City, UT
7. Western Automatic Sprinkler, Salt Lake City, UT
8. Preferred Fire Protection Company, Salt Lake City, UT
9. Aurora Fire Protection, Salt Lake City, UT
10. Shilo Automatic Sprinkler, inc.

C. Contractors not listed must submit for acceptance 10 calendar days prior to bid date. Proof of prior experience for Contractors not listed shall be submitted to the Engineer in writing, giving total and complete information of dates, name, address of owner, and location of all projects completed during past 3 years with specific references as to Engineers, and prime contractors involved. List names of companies, phone numbers and project manager's name.

D. Codes and Standards:

1. All work shall conform to the requirements of the following NFPA Standards and Recommended Practices as appropriate for the type of service except as specifically noted in each Section:

   a. "Installation of Sprinkler Systems", NFPA 13 - 2002 Edition.
   b. "Installation of Standpipe and Hose Systems", NFPA 14 - 2002 Edition.
   c. "Installation of Fire Pumps", NFPA 20 - 2002 Edition.
   d. "National Electrical Code", NFPA 70 - 2002 Edition.
   e. "National Fire Alarm Code", NFPA 72 - 2002 Edition.
   f. "Inspection, Maintenance and Testing of Water- Based Suppression Systems", NFPA 25 - 2002 Edition.

2. All building construction work shall conform to the 2006 International Building Code and 2006 International Fire Code.
3. All work shall conform to the federal, state and local regulations governing this installation.
4. Should any conflicts occur between any code or standard, the most stringent requirement(s) shall apply.
5. The Fire Protection Contractor shall be subject to the interpretation of statutory requirements by the Utah State Fire Marshal and Weber State Fire Marshal. Acceptance of the completed systems by the Utah State Fire Marshal and Weber State Fire Marshal is required.

1.9 TECHNICAL SUBMITTALS

A. Timely submittals are essential to on-time completion of the project. The Owner will incur no obligation to extend the contract completion date, or to reduce or waive any liquidated damages due, as a result of the Fire Protection Contractor's failure to provide the specified submittals in a timely and acceptable fashion.

B. The information shown on each technical submittal shall be complete with respect to quantities, dimensions, specified performance and design criteria, products, materials, and similar data to enable the Owner, Engineer and Architect to review the information as required. Only complete submittals will be reviewed. Incomplete submittals will be rejected and returned to the Fire Protection Contractor without being reviewed.

C. Each technical submittal shall include a cover letter providing a description of each variation that the submittal may have from the requirements of the Contract Documents. In addition, the Fire Protection Contractor shall provide specific notation on each Working Plan, sample, catalog cut, data sheet, installation manual, etc. submitted for review and approval, of each such variation.

D. No construction or installation will be authorized until the required submittals are received and reviewed by the Owner, Engineer, and Architect. Any construction or installation performed without written authorization from the Owner shall be entirely at the Fire Protection Contractor's own risk.

E. The required Technical Submittals for all systems and equipment installed in accordance with these specifications include:

1. Working Plans, per NFPA 13.
2. Water Supply Information, per NFPA 13.
3. Hydraulic Calculations, per NFPA 13.
4. Operation and Maintenance Manual.
5. Test Protocols.
6. Fire Protection Contractor’s Material & Test Certificates for Aboveground Piping and for Underground Piping, per NFPA 13.
7. Record Drawings.

F. Provide six copies of each required Working Plan, manufacturer’s data sheet, water supply information, hydraulic calculations, and test protocol submittal within 60 days of award of contract.

G. Provide two copies of each required Operation and Maintenance Manual, Material & Test Certificates, and Record Drawing submittal a minimum of 10 working days prior to final acceptance testing.

H. All drawings and diagrams shall be CAD generated using AutoCAD Version 2007, prepared on drawing sheets 30" x 42" in size, and shall contain no extraneous information. Marked up copies of catalog data sheets or manufacturer’s “typical” diagrams are not acceptable in lieu of the required drawings or diagrams. All other information required for this submittal shall be submitted in one or more appropriately labeled and indexed 3-ring binders.

I. All drawings and diagrams shall include the Fire Protection Contractor's title block, complete with drawing title, Fire Protection Contractor's name, address, date (including revisions), and preparer's and reviewer’s initials.

J. Upon approval of the Working Plans, including completion of any required revisions, the Fire Protection Contractor shall provide one (1) complete, reproducible set and three blueline sets for the Owner, Engineer, and Architect's use in performing field observations during construction.

K. Working Plans for sprinkler systems shall be complete and in full accordance with NFPA 13 Chapter on Plans and Calculations.

1. All drawings and calculations shall be reviewed and accepted by the jurisidictional fire department, building department fire marshal, as applicable, and the insurance carrier or insurance reviewing authority prior to submitting to the Engineer. Indication of review and acceptance by all agencies, as appropriate, shall be certified by name of reviewer, agency, and date affixed to the plans or reproducibles submitted to the Engineer. None will be accepted or reviewed until compliance with these terms has been established.

L. Operation and Maintenance Manuals shall be prepared specifically for this project and bound in an indexed 3-ring binder, containing:

1. A detailed description of routine maintenance and testing as required and recommended and as would be provided under a maintenance contract, including a testing and maintenance schedule and detailed testing and maintenance instructions for each type of device installed. This description shall include:

   a. A listing of the individual system components that require periodic testing and maintenance.
   b. Step-by-step instructions detailing the requisite testing and maintenance procedures and the intervals at which those procedures should be performed, for each type of device installed. These instructions shall include copies of NFPA 25 - Inspection, Testing and Maintenance of Water-Based Fire Protection Systems and NFPA 72 - National Fire Alarm Code.

2. A schedule, which correlates the step-by-step testing and maintenance procedures with the listing of individual components. This schedule shall be completed for the duration of the warranty period or for one complete testing/maintenance cycle whichever is longer.
3. A service directory, including installing company's name and telephone numbers for whoever should be called to obtain both normal warranty service and 24-hour emergency service.
4. Drawings and diagrams, as required.
5. System Calculations.
6. Test reports for system, flow rates, and residual pressures.
7. Certified pump curves (all pumps).
8. Wiring diagrams for all system devices.

M. Upon completion of the installation, submit Record Drawings and Contractor's Material & Test Certificates for Aboveground Piping and for Underground Piping, per NFPA 13.

N. Record Drawings shall include all variations from the approved Working Plans, for whatever reason, including those occasioned by modifications, change orders, optional materials and/or required coordination between trades. Variations shall be indicated in sufficient detail to accurately reflect the as-built conditions. Upon completion of the work, before final acceptance, the Fire Protection Contractor shall deliver to the Owner, two (2) additional full size sets of blue lines and one set of AutoCAD drawing data files.

1.10 PROJECT CONDITIONS

A. Contractor shall not install any piping until he has assured himself that the piping can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

B. Flow Test: Provide new flow test results.

1.11 WARRANTIES

A. Provide original copies of all warranties and extended warranties for specific equipment where specified and in accordance with Section 230500.

PART 2 - PRODUCTS

2.1 PRODUCT LISTINGS AND APPROVALS

A. All system components for which UL listings categories exist shall be listed by Underwriters Laboratories (UL) or Factory Mutual Research (FM).

1. All components shall be listed in the current edition of the UL Fire Protection Equipment Directory. Components shall be delivered to the project site with factory applied UL stickers.
2. Components for which UL listing approvals are “pending” are not acceptable.

B. All system components shall be used in accordance with the manufacturer’s recommendations and their listing.

C. All system components are subject to the approval of the engineer with regard to their fitness for the intended application.

2.2 UNDERGROUND EXTERIOR PIPING

A. Pipe, Fittings and Joints, Exterior and Buried:

1. General: The use of cast-iron, asbestos cement, steel, or other piping materials and systems is prohibited, unless specifically accepted by the Engineer.

2. Pipe Fittings and Joints:

   a. Ductile iron pipe with mechanical joint fittings. Joints to be provided with set screw retainer glands.

Make:	U.S. Pipe Company
Size:	2" thru 48"
Laying Condition:	Type 1
Thickness Class:	50 or 51 as required by U.S. Pipe.
Standards:	ANSI A21.SD/A21.51 AWWA C-150/151, U.L., F.M., NSF.
Pressure Rating:	250 psi
Fittings:	Ductile iron conforming to ANSI A21.10/A21.16 and AWWA C-110/111.
Retaining Glands:	Set screw type ductile.
Hydrant Connections:	Tee DI rotatable x MJ Hydrant Connector. DI rotatable 13" long x MJ

3. Polyvinylchloride pipe with mechanical joint, ductile fittings, and joint restraints:

Make:	Manville "Blue Brute".
Size:	4" thru 12"
Laying Condition:	Type 1 as defined by U.S. Pipe Co.
Class:	200 (DR 14) as determined by dia. of pipe O.D. divided by the wall thickness (SDR method) conforming to ASTM D-1599 burst test (985 psi minimum) and minimum 100 ft-lbs of impact per ASTM D-2444. Meet all requirements of AWWA C-900, U.L., F.M., and N.S.F.
Pressure Rating:	200 psi minimum operating @ 73 deg. F
Fittings:	Ductile iron conforming to ANSI A21.10/A21.11 and AWWA C-110/111 Mechanical Joint pattern only.
Retaining Glands:	Do not use set screw retaining glands on this pipe. Use felt padded pipe clamps, coated rods, and concrete thrust blocks for all turns, offsets, and fittings.

Note: Straight lengths of piping, not offset or deflected, may be J-M "Ring Tite" locked joints in lieu of mechanical joint ductile iron connectors or fittings.

4. Fiberglass reinforced PVC pipe with mechanical joint ductile iron fittings, for use where pressures exceed 200 psi up to 350 psi:

Make:	Manville "Blue Brute".
Size:	4" thru 12"
Laying Condition:	Type 1 as defined by U.S. Pipe Co.
Class:	350 (4"=DR 32, 6" & 8"=DR 36, 10" & 12"=DR 41)
Pressure Rating:	350 psi minimum operating @ 73 deg. F
Fittings:	Ductile iron conforming to ANSI A21.10/A21.11 and AWWA C-110/111 Mechanical Joint pattern.
Retaining Glands:	Do not use set screw retaining glands on this pipe. Use felt padded pipe clamps and coated rods and concrete thrust blocks for all turns, offsets, and fittings.

Note: Straight lengths of piping not offset or deflected may be J-M "Lock-ring" joints in lieu of mechanical joint fittings or connectors.

5. Rotatable Fittings:

   a. Provide for all service risers, fire hydrants and valves, U.S. Pipe Company U-591 and U-592 MJ x PE or rotatable MJ gland tees and connecting pieces to provide plumb and true hydrant, valve and service riser settings.

B. Tapping Tees and Valves:

1. Where the water utility does not install its own service tap, provide tapping tees and valves for wet taps. Provide service saddle, valve, and service box with indexed cover in accordance with the utility's standards.

C. Detector Check and Backflow Preventer:

1. Provide detector check valves with meters as required for detection of 1-20 gpm leak rate. Febco 406DC, or approved equal.

D. Thrust Blocks - Tie Rods:

2. Provide 3000 lb type II concrete thrust blocks with soil contact area based on not more than 2000 psf horizontal soil bearing quality, and enveloping 1/2 of pipe, fitting, or valve. Provide saddle reinforcing as required.
3. Submit calculations for each thrust block and dead man provided.
   Provide 1/2" minimum machine thread rods and clamps (felt padded clamps for plastic pipe) on all service entries from last joint underground to riser elbow or wall entry and to first joint in the building. All rods, clamps, and bolts double coated with "ZRC" brand cold galvanizing coating after installation and draw up. Provide 1 coat of coal tar coating over galvanizing. NOTE: Clamps and rods to not preclude the requirements for thrust blocks or deadmen.

2.3 SOLVENTS FOR PLASTIC PIPING

A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule 1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

2.4 INTERIOR AND EXTERIOR ABOVE-GROUND PIPING

A. Pipe and Joints:

1. Black steel and galvanized steel threaded or roll grooved schedule 40 conforming to ASTM A-135 or A-53. All pipe shall conform to NFPA #13, Chapter 3 and Jurisdictional Authorities and Insurance Agency. Where required to meet insurance agency or jurisdictional requirements, all dry pipe system and drain piping shall be galvanized.

B. Fittings:

1. Threaded cast iron, pressure class in accordance with developed system pressures, conforming to ASME B16.4. Threaded malleable iron, pressure class in accordance with developed system pressures, conforming to ASME B16.3.
2. Weld type fittings: Buttweld conforming to ASME B16.9. Flanges conforming to ASME B16.25. Socket weld conforming to ASME B16.11. All welds by certified welder in accordance with Section 230529.
3. Grooved fittings shall conform to ASTM-A47 (malleable), ASTM 536 (ductile), or ASTM-106 GRB (forged steel), ASTM A-53 type E, F, or S GRB (nipples), ASME B-16.5 or B16.1 cast iron and carbon steel flanges.

C. Flexible Connectors:

1. Flexible connector to be stainless steel (304) corrugated tube surrounded with stainless steel (304) wire braid. Provide threaded fittings on each end of the flexible connector.
2. Connector shall have the frictional equivalent of a maximum of 23 ft. of 1” steel pipe (assumes 4’ long tube with four 90° bends).
3. Connectors shall be UL listed, F.M. approved.
4. Provide with support bracing and clamps.

D. Valves:

1. All valves are to be indicating type.
2. All valves U.L. listed, F.M. approved.
3. Refer to Section 230529 for valve specifications.

E. Hangers:

1. All hangers, attachments and components U.L. listed, F.M. approved.
2. All piping hangers shall conform to Jurisdictional Authorities requirements.
3. Powder driven studs shall not be included in normal installation. Permission to use this type anchoring system must be accepted by the Structural Engineer prior to submitting pricing or bids to any contractor or agent relative to this project.

2.5 SPRINKLER SYSTEM

A. Acceptable Manufacturers: The following manufacturers are acceptable, providing the product to be considered is equivalent in every respect to the nomenclature, style, material, finish, and color provided by the specified make and model.

1. Sprinkler Heads, Alarm, Dry and Deluge Valves, Accelerators, Detector Check Valves, Water Motor Gongs, Air Maintenance Devices, Sprinkler Emergency Cabinets, and Specialties: Automatic, Central, Grinnell, Gem, Reliable, Viking, Notifier, Victaulic, Croker, Potter, Elkhart, Tyco, Star.

B. Sprinkler Heads:

Heads shall be U.L. Listed and of the type required to properly protect the intended space. Heads shall be of ordinary-temperature classification except as required by ceiling temperature, location, or service as allowed or required by code. Provide quick-response heads in all light hazard occupancies and all dwelling units, all guest rooms and sleeping rooms.

LOCATION	**ORIENTATION**	**HEAD FINISH**	**COVER OR ESCUTCHEON**
Lounge Rooms	Recessed	Chrome	Chrome
Elevator Lobbies	Recessed	Chrome	Chrome
Entry Lobby	Recessed	Chrome	Chrome
Storage	Recessed	Brass	Chrome
Corridors	Recessed	Brass	White
Open Areas (No Ceilings)	Upright/Pendant	Brass	-
Equipment Rooms	Upright/Pendant	Brass	Chrome
Suites	Concealed	Brass	White
All Gypboard ceilings	Concealed	Brass	White

C. Escutcheons shall be part of the U.L. Listed sprinkler assembly.

D. Sprinkler Head Cabinets:

1. Steel with red enamel finish for 6, 12, or 24 heads complete with appropriate heads, wrench and mounting.

E. Sprinkler Head Guard:

1. Steel wire cage, chrome finish. Guards shall be placed on fire sprinkler heads where mechanical or physical damage may occur.

F. Water Flow and Pressure Switches:

1. Paddle Type Flow Switch U.L. Listed, for pipe sizes 1" thru 8", for vertical or horizontal mounting, retard adjustment from 0 to 70 seconds instantly recycling, 10 amp, 120v AC, dual contacts. Notifier Model WFD, or approved equal.

G. Supervisory Switches:

1. Post indicator valve, and gear operator type, U.L. Listed, weatherproof metal housing, threaded conduit entrance, 10 amp, 120v AC, dual contacts. Notifier Model PIBV2, or approved equal.
2. Gate, OS&Y, and other exposed rising stem type valves, U.L. Listed, weatherproof metal housing, threaded conduit entrance, 10 amp, 120v AC, dual contacts. Notifier Model OSY2, or approved equal.

H. Alarms:

1. Exterior Audible and Visual Alarm, U.L. Listed for outdoor use, weatherproof faceplate, horn and strobe. Notifier Model GMS, or approved equal.
2. Alarm Valves, Wet Pipe System: U.L. Listed, alarm check valve. Central Model F-2 & G, or approved equal.
   a. Provide with pressure switch variable pressure trim with retard and closed retard drain for use with pressure switch as required.

2.6 STANDPIPE SYSTEM

A. Acceptable Manufacturers: The following manufacturers are acceptable, providing the product to be considered is equivalent in every respect to the nomenclature, style, material, finish and color provided by the specified make and model.

Hose cabinets, hose racks, valves and regulating valves: Croker, Moon, Elkhart, Potter, Powhattan, Sierra, Goodall, Allenco, Tyco, Reliable, Viking, Victaulic.

B. Cabinets:

1. Fire Hose Cabinet: Recessed welded steel cabinet, continuous steel hinge, white finish. Steel door frame, full panel door with plexiglass window.
2. Fire Valve Cabinet: Recessed welded steel cabinet, continuous steel hinge, white finish. Steel door frame, full panel door with plexiglass window.

C. Hose Valves: U.L. Listed, FM approved, globe type, polished brass finish.

1. Provide pressure limiting valves for stand pipe outlets and sprinkler supply as required.

2.7 ROOF MANIFOLD

A. Cast brass, straight or angle pattern. Provide roof manifold of size , style, and pattern required. Provide control valve, stem extension, wall or floor stand, index plate, and cap and chain.

PART 3 - EXECUTION

3.1 PREPARATION

A. Field Measurements: Verify all dimensions before proceeding with the work. Obtain field measurements for work required to be accurately fitted to other construction. Be responsible for the accuracy of such measurements and precise fitting and assembly of finished work. Prefabrication of systems is done at this Contractor's own risk.

B. Coordination: Coordinate all work and placement of components with other trades, thorough coordination of design and field installation is expected. Remedial field work may be required to eliminate conflicts and provide an acceptable finished product.

3.2 EXCAVATION, BACKFILL, CUTS AND RESTORATION

A. Provide all excavations and backfill in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Cuts - Restoration:

1. All concrete, asphalt, or other hard permanent surface shall be saw cut. Turf areas shall be cut clean with straight edge.
2. Restore all planted, paved, and surfaced areas to original color, texture and condition, replanting where necessary and left in the same or better condition as was found existing.

3.3 INSTALLATION

A. General: Provide a complete operable system designed and installed in accordance with applicable local, state, federal and jurisdictional codes, enforcement agencies and insurance rating or underwriting agencies.

B. All systems shall be drainable with proper drainage devices, and drain terminations either to exterior of building or to proper receptacles within building.

C. All systems shall be supported and braced for conformance to proper and applicable standards.

D. Care shall be taken with chrome plated or other polished finish components so that marring does not occur to the finish, and installation provides for a uniform pattern and true installation.

E. Where piping passes thru masonry units or concrete walls or floors or other building construction, sleeves may be used. Where exposed piping passes thru finished work, chrome plated, or other finish acceptable to Architect, split wall plates or escutcheons shall be installed to fit snugly around piping. Where rated walls are penetrated, approved safing shall be provided at each hole to assure effectiveness of construction as a fire stop.

F. All openings for piping should be anticipated and coordinated with General Contractor. Indicate such openings on the shop drawings. Any additional cutting of openings must be coordinated with the General Contractor.

G. Contractor shall complete the automatic fire sprinkler ready for operation, in all respects, as soon as possible. When system is complete and ready for continuous operation, activate the system for its intended use. After system has been activated for continuous use, water charges, if any will be paid for by the Owner.

H. Use no face bushings.

I. Furnish and install all wiring for all flow switches, tamper switches, exterior and interior alarm items furnished in this Section. This work may be subcontracted to the Division 26 Contractor if desired by the Section 211000 Contractor but the Section 211000 Contractor shall include the wiring costs in his bid.

J. Provide seismic restraints in accordance with Jurisdictional Agencies.

K. The sprinkler piping shall be concealed from view in all common and public areas with a finished ceiling. Exposed piping shall be cleaned and left ready for painting by others.

L. Provide seismic separation assembly in accordance with NFPA 13 where pipes cross building seismic separation joints or expansion joints.

3.4 PERFORMANCE

A. General: Systems shall be engineered and designed for proper densities, ease of maintenance and accessibility. Final main drain flow tests shall be made to prove system design and installation.

3.5 CLEANING

A. General: Flush all systems free of all debris and certify system clean and ready for use.

3.6 TESTING AND CERTIFICATE OF COMPLETION

A. The entire system shall be hydrostatically tested at not less than 200 psig for not less than 2 hours with 0 psig pressure drop. Tests shall be conducted by the Weber State Fire Marshal’s Office. Tests shall be witnessed by the Architect's or General Contractor’s representative - mandatory.

B. Obtain certificate of compliance and completion for jurisdictional agencies, as applicable and present to Owner - mandatory.

END OF SECTION 211000

FIRE FLOW TEST REPORT
CBPE # 390-1
Date: 2/10/10

CBPE
Craig Blue, P.E. Inc.
Fire Suppression Design
Consulting & Engineering
1971 West 3300 South, #A 801-886-3473, Fax-886-3493
West Valley City, UT 84119 Craig@CBluePE.com

This report contains the assessment of the water supply available for fire protection at the following site/address:

Weber State Campus
4100 S. Street
Ogden, Utah

Report was prepared at the direction of:
Mark Halverson Weber State University
Campus Construction Dept
Ogden, UT

Prepared by:
Craig Blue, P.E.

Background Information:

The purpose of this report is to determine the amount of water supply available at the site noted above. The report shall assist authorities having jurisdiction, in determining fire suppression requirements & issuing of building permits. Comments included in report, that references 2006 International Building/Fire code are based on minimum recommended standards only. The authorities having jurisdiction may require more or less than the reference appendix.

Water & hydrants to site is provided by Weber Campus private water system and supplied by Ogden Water District. Location of hydrants used for test are noted on drawing.

Flow Test:
The flow test was performed by Craig Blue PE & Dennis Montgomery, Campus Fire Marshal.
Water flow and pressures available at hydrants nearest to site are as follows:

Static Pressure: 85 psi
Residual Pressure: .. 65 psi
Flowing 1 outlets (2.5”): 1337 gpm
Reference elevation- 4500 ft. approx.
See flow data sheet for site plan, and hydrants reference.
Fire flow calculated: 2527 gpm at 20 psi,

Proposed buildings shall be provided with fire Sprinklers. This allows fire flow to be reduced by 75% per exception of B105.2. In accordance with Appendix table B105.1 maximum required flow of 8000 gpm for any structure type may be reduced to 2000 gpm. Structure type and area is considered unlimited per the reduction and fire flow available to site.

Fire flow to site is considered reliable and sufficient to meet the fire flow demands.

Fire Sprinkler system should be designed using a minimum 10% pressure reduction for a margin of safety and future growth in area . Reduced design data shall be as follows:

Static Pressure: 76 psi
Residual Pressure: 58 psi
Flowing: 1337 gpm

If there are further questions, please contact me
Craig Blue,P.E.

Attached:
Flow Data Sheet & Chart
Referenced IFC code sections.

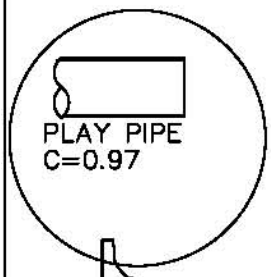
FLOW TEST DATA SHEET

CBPE
Craig Blue, P.E. Inc.
Fire Suppression Design
Consulting & Engineering
1971 West 3300 South, #A
West Valley City, UT 84119
801-886-3473, Fax-886-3493
Craig@CBluePE.com

CBPE: 390-1

WATER SYSTEM: WSU Campus utilities- Ogden Water Dist.
NAME OF PROPERTY: Weber State Campus-
ADDRESS: 4100 south
Ogden Utah
DATE: 2/1/10 TIME: 10:00 am TEMPERATURE: +40°F
TYPE OF CITY SYSTEM: x
TEST CONDUCTED BY: Craig Blue Pe
WITNESSED BY: Dennis Montgomery- Campus Fire Marshal
NOTES: x

OUTLET TYPES:



PLAY PIPE
C=0.97

SMOOTH
C=0.90

SQUARE
C=0.80

PROJECTED
C=0.70

FORMULA: $Q = 29.83\ CD^2\sqrt{P}$

WHERE Q IS GALLONS PER MINUTE
C IS THE COEFFICIENT OF DISCHARGE
D IS I.D. IN INCHES OF OUTLET (2.469" typ.)
P IS PITOT GAUGE READING (PSI)

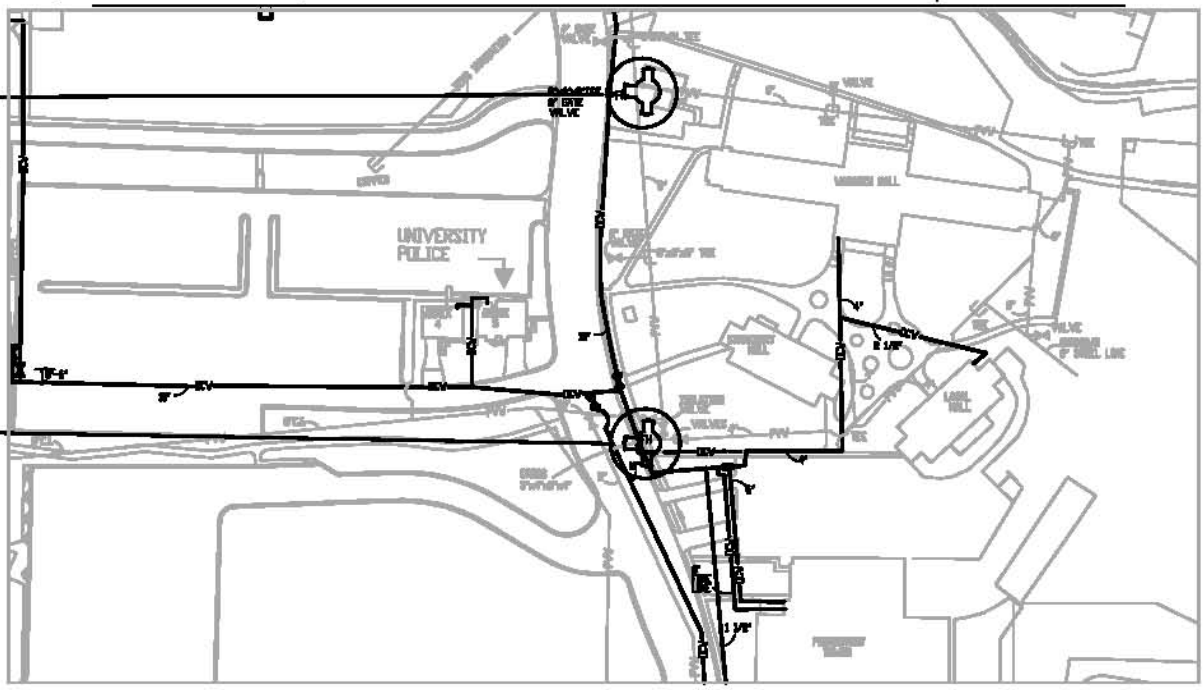
	SIZE (IN)	PITOT (PSI)	FLOW (GPM)
OUTLET 1	2.703	40	1337
OUTLET 2			
OUTLET 3			
OUTLET 4			
FIRE FLOW: 2527 @ 20psi		TOTAL FLOW: 1337	

STATIC: 85 PSI RESIDUAL: 65 PSI ELEVATION: 4500 ft approx.

SKETCH AREA MAP BELOW: North at top of sheet

HYDRANT:
85 psi Static
65 psi Residual
Elev: 4500 ft.
approx.

HYDRANT:
40 psi pitot
flowing 1327
gpm



CBPE
Craig Blue, P.E. Inc.
Fire Suppression Design
Consulting & Engineering
1971 West 3300 South, #A
West Valley City, UT 84119
801-886-3473, Fax-886-3493
Craig@CBluePE.com

FLOW TEST DATA CHART

CBPE: 390-1

WATER SYSTEM: WSU Campus utilities- Ogden Water Dist.

NAME OF PROPERTY: Weber State Campus-

ADDRESS: 4100 south
Ogden Utah

SUPPLY: 85 PSI (STATIC) 65 PSI (RESIDUAL) 1337 GPM (FLOWING) ELEVATION: 4500 ft approx.

DATE OF TEST: 2/01/10

Water system is considered reliable and sufficient for proposed

Fire sprinkler system shall be designed with a minimum 10% reduction for pressures available, to provide a safety margin for future system demands.

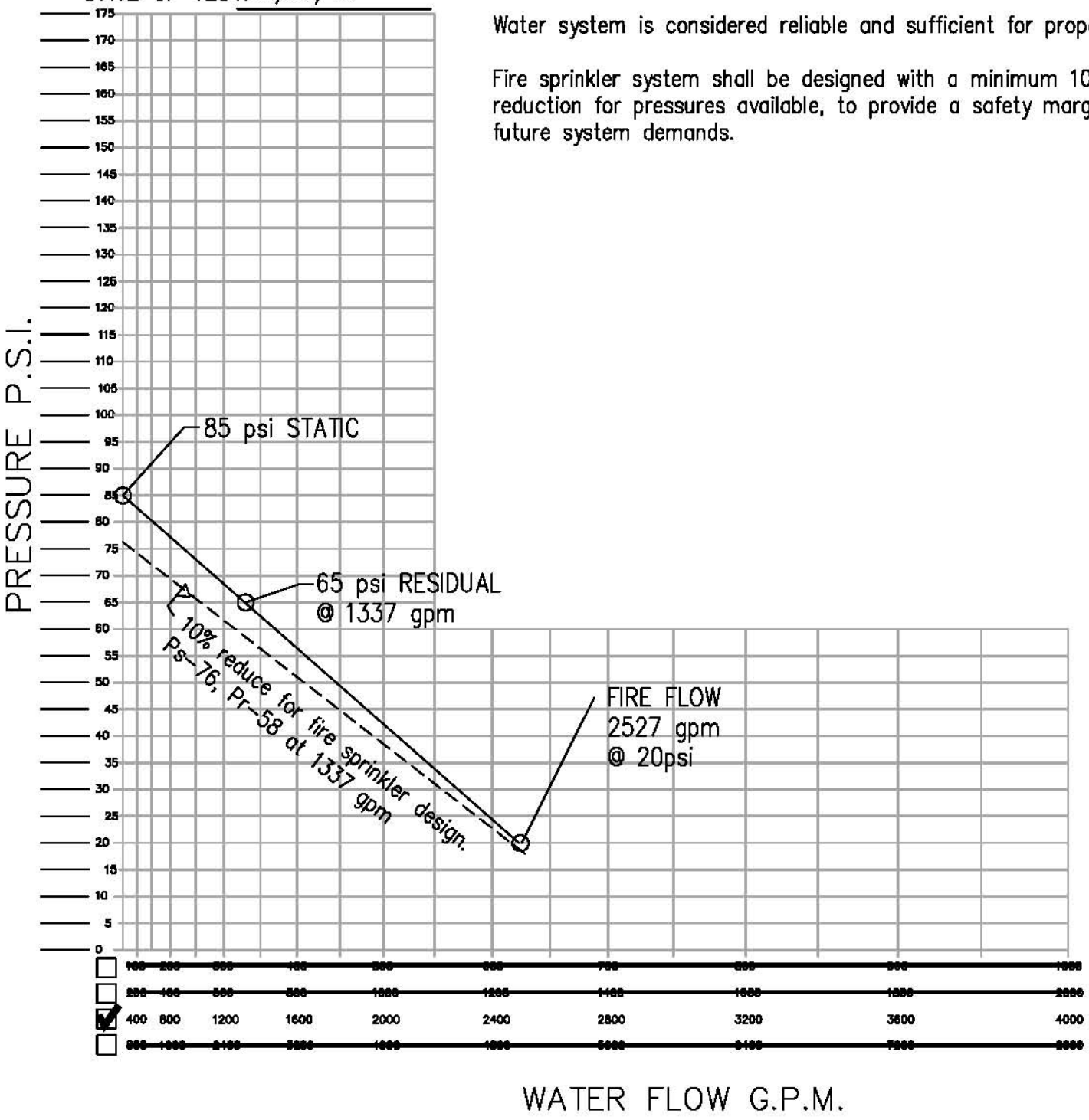


CHART #1

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Codes and Standards:
   1. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of potable water system materials and products.
   2. Water Purveyor Compliance: Comply with requirements of Purveyor supplying water to project, obtain required permits and inspections.
   3. NFPA Compliance: Install fire water systems in accordance with NFPA 24 "Standard for Installation of Private Fire Service Mains and Their Appurtenances".
   4. Local Fire Department/Marshall Regulations: Comply with governing regulations pertaining to hydrants, including hose unit threading and similar matching of connections.
   5. UL Compliance: Provide fire hydrants that comply with UL 246 "Hydrants for Fire-Protection Service", and are listed by UL.

1.2 SUMMARY

A. This Section includes pressure water pipes and fire systems outside the building, with the following components:

   1. Special fittings for expansion and deflection.
   2. Pipes and valves.
   3. Fire Hydrants.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

B. DI: Ductile Iron pressure pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Pressure Rating: 175 psi static water pressure for all pipes and fittings. Pipe joints shall be water tight.

1.5 SUBMITTALS

A. Product Data: For the following:

   1. Special pipe fittings.

2. Fire hydrants
3. Valves.
4. Valve boxes and appurtenances.
5. Pipes.
6. Disinfection reports and practices
7. Product Data: Submit manufacturer's technical product data and installation instructions for fire water system materials and products.
8. Maintenance Data: Submit maintenance data and parts lists for fire water system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual.

B. Shop Drawings: For the following:

1. Thrust Blocks: Include plans, elevations, sections, details, and forces for thrust blocks for each size of pipe and type of bend.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping and sewer system piping. Indicate interface and spatial relationship between piping and proximate structures.

D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

E. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.7 PROJECT CONDITIONS

A. Interruption of Water Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of service. Coordinate interruptions during weekly meetings and at pre-construction meeting.
2. Do not proceed with interruption of service without Architect's, Construction Manager's, and Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work.

2. Line Markers:
   a. Allen Systems Inc.
   b. Seton Name Plate Corp.
   c. Engineer Approved Equal.
3. Pipe Strainers:
   a. "Automatic" Sprinkler Corp. of America; Div. A-T-O Inc.
   b. Cleveland Gear Co.; Sub of Vesper Corp.
   c. Grinnell Fire Protection Systems Co., Inc.
   d. Hersey Products Inc.; Hersey Div.
   e. Mueller Steam Specialty; Div. of Core Industries Inc.
   f. Neptune Water Meter Co.
   g. Rockwell International Corp.; Municipal & Utility Div.
   h. Rockwood Systems Corp.
   i. Zurn Industries Inc.; Fluid Handling Div.
4. Detector Meter: Not Required
5. Gate Valves:
   a. American Valve Mfg. Corp.
   b. American-Darling Valve; Div. of American Cast Iron Pipe Co.
   c. Clow Corp.; Valve Div.
   d. Dresser Mfg. Div. of ITT Grinnell Valve Co. Inc.
   e. Fairbanks Co.
   f. Kennedy Valve; Div. of ITT Grinnell Valve Co., Inc.
   g. Stockham Valves & Fittings Inc.
   h. United Brass Works Inc.
   i. United States Pipe and Foundry Co.
   j. Waterous Co.
6. Check Valves:
   a. American-Darling Valve; Div. of American Cast Iron Pipe Co.
   b. Clow Corp.; Valve Corp.
   c. Fairbanks Co.
   d. Kennedy Valve; Div. of ITT Grinnell Valve Co., Inc.
   e. Mueller Co.
   f. Nibbco Inc.
   g. Stockham Valves & Fittings Inc.
   h. Walworth Co.
   i. Waterous Co.
7. Yard Hydrants
   a. Josam Mfg. Co.
   b. Smith (Jay R.) Mfg. Co.
   c. Zern Industries, Inc.; Hydromechanics Div.
8. Fire Hydrants: Approved by authority having jurisdiction.
9. Backflow Preventors: Approved by authority having jurisdiction.

2.2 IDENTIFICATION

A. Underground –Type Plastic Line Markers: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide blue tape with black printing reading "CAUTION WATER LINE BURIED BELOW".

B. Nonmetallic Piping Label: If nonmetallic piping is used for water service, provide engraved plastic laminate, label permanently affixed to main electrical meter panel stating "THIS STRUCTURE HAS A NONMETALLIC WATER SERVICE".

2.3 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

B. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in potable water systems. Where more than one type of materials or products are indicated, selection is Installer's option.

C. Piping: Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.

D. Ductile Iron Pipe: Polyethylene wrapped Ductile Iron Class 350, with cement mortar lining complying with AWWA C104.
   1. Fitting: Ductile iron AWWA C110; cement lined AWWA C104; and rubber-gasket joints, AWWA C111.

E. Copper Tube: ASTM B 88; type K, soft-annealed temper (for 3/4" to 2" diameter pipe).

2.4 WATER METER

A. Not Used.

2.5 VALVES

A. Gate Valves: UL-listed, 175 psi working pressure for 12" and smaller, 150 psi for sizes larger than 12". Threaded, flanged, hub, or other end configurations to suit size of valve and piping connection. Inside screw type for use with indicator post, iron body bronze mounted, non- rising stem, solid wedge disc.

B. Check Valves: UL-listed, 175 psi working pressure for 2" through 12", 150 psi for sizes larger than 12". Swing type, iron body bronze mounted with metal-to-metal or rubber-faced checks. Threaded, flanged, or hub end, to suit size and piping connections.

2.6 FIRE HYDRANT

A. Provide cast-iron body fire hydrants, compression type, opening against pressure and closing with pressure, base valve design, 200 psi working pressure, with 1/4" gage tapping and bronze plug in standpipe, conforming to the latest edition of AWWA C-502, "Dry Barrel Fire Hydrants."

B. Features: Provide the following features:
1. Size: 5" valve opening.
2. Direction to Open Hydrant: Left.
3. Size and Shape of Operating and Cap Nuts: Pentagon 1-1/2" point to flat.
4. Hose Nozzles: 2-1/2" National Standard Thread cap and chain.
5. Pumper Nozzles: 5" National Standard Thread cap and chain.
6. Depth of Trench: 4'-6".
7. Connnection to Main: 6" mechanical joint.

2.7 ACCESSORIES

A. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.

B. Clamps, Straps, and Washers: Steel, ASTM A 506.

C. Rods: Steel, ASTM A 575.

D. Rod Couplings: Malleable-iron, ASTM A 197.

E. Bolts: Steel, ASTM A 307.

F. Cast-Iron Washers: Gray-iron, ASTM A 126.

G. Thrust Blocks: Concrete, 3,000 psi.

2.8 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Thrust Blocks, Hydrant Supports, and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.

PART 3 - EXECUTION

3.1 Examination: Examine areas and conditions under which potable water system's materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 EARTHWORK

A. Excavation trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.3 INSTALLATION

A. Identification: During back-filling/top-soiling of underground fire water piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. If pvc pipe is used, install a tracer wire along the top of the pipe, secured with tape, and extending to fire hydrants and valves.

B. Pipe and pipe fittings:
   1. Pipe: Install in accordance with AWWA C600 "Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances".
   2. Depth of Cover: Provide minimum depth of cover over underground piping in accordance with NFPA 24, Figure A-8-11 "Recommended Depth of Cover Above Top of Underground Yard Mains" or 60" below finish grade, whichever is greater.

C. Piping Specialties:
   1. Pipe Line Strainers: Install as indicated, with valved blowoff piped to drain.

D. Meters: Install as indicated with shutoff valve on either side of meter and valved bypass full line size.

E. Valves: Provide post indicator for control valves.
   1. Shutoff Valves: Install shutoff valve ahead of each hydrant.

F. Hydrants: Install fire hydrants in accordance with AWWA M17 "Installation, Operation, and Maintenance of Fire Hydrants".
   1. Location: Install fire hydrants minimum of 40'-0" from building outside wall, as indicated, or if not shown.
   2. Face hydrants towards drive.
   3. Place hydrants so that base of hydrant is even to 6-inches above adjacent top back of curb.

3.4 PIPING APPLICATIONS

A. Pipe:
   1. Ductile Iron Pipe: Install in accordance with AWWA C600 "standard for installation of ductile-iron water mains and their appurtenances" and in accordance with instructions from water purveyor.
   2. Copper Tube: Install in accordance with CDA "Copper Tube Handbook".
   3. PVC Pressure pipe, PVC pressure fittings, gaskets, and gasketed joints.

B. Depth of Cover: Provide minimum cover over piping of 12" below average local frost depth or 42" below finished grade, whichever is greater.

C. Water Main Connection: Arrange and pay for tap in water main, of size and in location as indicated, from water Purveyor.

D. Water Service Termination: Terminate potable water piping 5'-0" from building foundation in location and invert as indicated. Provide temporary pipe plug for piping extension into building.
   1. Mark location with surface marker.

3.5 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground water pipes. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

C. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

D. Install piping according to the following:

   1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
   2. Install piping with line and grade as indicated or below frost line if not inidcated.
   3. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
   4. Install ductile-iron special fittings according to AWWA C600.
   5. Install PVC pressure piping according to AWWA M23 or ASTM D 2774 and ASTM F 1668.
   6. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.

3.6 INSTALLATION OF VALVES

A. Install valves with stems pointing up. Provide valve box over underground valves.

3.7 INSTALLATION OF WATER METER AND VAULT

A. Install Water Meter and Vault to comply with City Water Department Standards.

3.8 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join pressure piping according to the following:

1. Join ductile-iron pressure piping according to AWWA C660 or AWWA M41 for push-on joints.
2. Join ductile-iron special fittings according to AWWA C660 or AWWA M41 for push-on joints.
3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
4. Join PVC water-service piping according to ASTM D 2855 for solvent-cemented joints.

C. Join dissimilar pipe materials with pressure-type couplings.

3.9 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened. Fill pipeline with water 24-hrs prior to testing, and apply test pressure to stabilize system.

B. Hydrostatic Tests: Test at not less than 200 psi for 2-hrs, or at 50 psi above maximum static pressure if it is greater than 150 psi.
1. Test fails if leakage exceeds 2-qts per hour per 100 gaskets or joints irrespective of pipe diameter.
2. Increase pressure in 50 psi increments and inspect each joint between increments. Hold at test pressure for one hour, decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour.

C. Operating Tests: Open and close all valves and hydrants under system water pressure. Check dry barrel hydrants for proper drainage.
1. For systems with fire pumps, run pumps during operating tests.

3.10 ADJUSTING AND CLEANING WATER MAINS

A. Disinfection of Potable Water System: Flush pipe system with clean potable water until no dirty water appears at point of outlet. Fill system with water-chlorine solution containing at least 50 ppm of chlorine. Valve off system and let stand for 24- hrs minimum. Flush with clean potable water until no chlorine remains in water coming from system.
1. Repeat procedure if contamination is present in bacteriological examination.

B. Disinfection of Water Mains: Flush and disinfect in accordance with AWWA C651 "Standard for Disinfecting Water Mains".
1. Contractor shall submit written verification to Project Manager stating, Disinfection has been completed in strict compliance with specification for this project and with jurisdiction having authority over water system.

3.11 ADJUSTING AND CLEANING FIRE SYSTEM

A. Flushing: Flush underground mains and lead-in connections to sprinkler risers before connection is made to sprinklers, standpipes, or other fire protection system piping.
1. Flush at flow rate not less than that indicated in NFPA 24, or at hydraulically calculated water demand rate of the system, whichever is greater.

B. Adjusting: adjust fire hydrants to face street and be have base 2-6 inches above adjacent curb and gutter.

3.12 CLOSING ABANDONED WATER SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Backfill to grade according to Division 31 Section "Earth Moving."

END OF SECTION 221113

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SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:

1. Special fittings for expansion and deflection.
2. Cleanouts.
3. Drains.
4. Precast concrete manholes.
5. Cast in place manhole bases over existing pipes.
6. Sewerage Pipes.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Sewer-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least water tight under specified head, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Special pipe fittings.
2. Cleanout materials.
3. Pipes.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

E. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect, Construction Manager and Owner no fewer than two days in advance of proposed interruption of service. Coordinate interruptions during weekly meetings and at pre-construction meeting.
2. Do not proceed with interruption of service without Architect's, Construction Manager's, and Owner's written permission.
3. If shutdown will affect city streets, other city utilities, or city sewer line, do not proceed without approval from city.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include local pre-cast manufacturers but are subject to approval of the engineer and architect.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 DUCTILE-IRON PRESSURE PIPE AND FITTINGS

A. Pipe: AWWA C151, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.5 PVC PIPE AND FITTINGS

A. PVC Pressure Pipe: AWWA C900, Class 150 for gasketed joints and using ASTM F 477, elastomeric seals.

1. Fittings NPS 4 to NPS 8: PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.
2. Fittings NPS 10 and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.

B. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 80 pipe, with plain ends for solvent-cemented joints with ASTM D 2467, Schedule 80, socket-type fittings.

C. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

D. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T 2 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

E. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.6 NONPRESSURE-TYPE PIPE COUPLINGS

A. Use non-pressure type couplings only when pipes can not be connected together with standard fittings and typical pipe connections such as bell and spigot. If possible, file the end on existing pipes to create spigot type connections to match existing pipe ends for connection to a new bell for an extension of the pipe.

B. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

C. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.

3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

D. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. NDS Inc.
f. Plastic Oddities, Inc.

E. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg.
b. Dallas Specialty & Mfg. Co.
c. Mission Rubber Company; a division of MCP Industries, Inc.

F. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

1. Manufacturers:

a. Fernco Inc.
b. Logan Clay Products Company (The).
c. Mission Rubber Company; a division of MCP Industries, Inc.

2.7 PRESSURE-TYPE PIPE COUPLINGS

A. Reducing or transition, metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 150-psig minimum pressure rating and ends of same sizes as piping to be joined. For pressure pipe, use these couplers when pipes can not be extended using existing pipe connections such as bell and spigots.

B. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.

1. Manufacturers:

a. Cascade Waterworks Mfg.
b. Dresser, Inc.; DMD Div.
c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc.
g. Viking Johnson.

2. Center-Sleeve Material: Manufacturer's standard.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Couplings: With split sleeve with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.

1. Manufacturers:

a. Brico Industries.

2. Sleeve Material: Manufacturer's standard.
3. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
4. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
5. Metal Component Finish: Corrosion-resistant coating or material.

2.8 SPECIAL PIPE FITTINGS

A. Ductile-Iron Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include 2 gasketed ball-joint sections and 1 or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.

1. Manufacturers:

a. EBAA Iron Sales, Inc.
b. Romac Industries, Inc.
c. Star Pipe Products.

B. Ductile-Iron Deflection Fittings: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for up to 15 degrees of deflection.

1. Manufacturers:

a. EBAA Iron Sales, Inc.

C. Ductile-Iron Expansion Joints: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated.

1. Manufacturers:

a. Dresser, Inc.; DMD Div.
b. EBAA Iron Sales, Inc.
c. JCM Industries.
d. Smith-Blair, Inc.

2.9 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Manufacturers:

   a. Josam Company.
   b. MIFAB Manufacturing, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Wade Div.; Tyler Pipe.
   e. Watts Industries, Inc.
   f. Watts Industries, Inc.; Enpoco, Inc. Div.
   g. Zurn Industries, Inc.; Zurn Specification Drainage Operation.

2. Top-Loading Classification(s): Light, Medium, Heavy, and Extra-heavy duty depending on location and expected driving load on cleanout.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Place in grey iron housing with clamping device and round, secured, scoriated, gray-iron cover.

1. Manufacturers:
   a. Canplas Inc.
   b. Josam Company
   c. MIFAB Manufacturing, Inc.
   d. Wad Div.; Tyler Pipe
   e. Watts Industries, Inc.
   f. Zern Industries, Inc; Zern Specification Drainage Operation
   g. IPS Corporation.
   h. NDS Inc.
   i. Plastic Oddities, Inc.
   j. Sioux Chief Manufacturing Company, Inc.
   k. Zurn Industries, Inc.; Zurn Light Commercial Specialty Plumbing Products.

2.10 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum, unless otherwise indicated and as needed for pipe sizes.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 9-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Not used.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
11. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."

    a. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48, Class 35 gray iron, unless otherwise indicated and to match existing manhole frames and covers.
    b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 15-mil minimum thickness applied to all surfaces, unless otherwise indicated.

B. Cast-in-Place Concrete Manholes Base: Construct of reinforced-concrete bottom according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
1. Ballast: Increase thickness of concrete, as required to prevent flotation.
2. Excavate around existing pipe where manhole is to be placed.
3. Place new pipe stub at line and grade and stubbed into new manhole location with pipe extending towards existing pipes.
4. Place CMU blocks or other approved support adjacent to pipes to support new barrel section.
5. Set first barrel section on CMU blocks and verify that barrel section is level in all directions and is not sitting on pipes.
6. Make sure that hole is deep enough that the depth of concrete will be 9-inches below existing and new pipes.
7. Place concrete around barrel section and inside barrel section so that the existing and new pipes are at least 50% covered with concrete.
8. Hand form trough as needed.
9. Let concrete cure and break out of pipes for trough. Grout all troughs smooth and even with pipes.
10. Stack remaining barrel sections and add cone, ring and cover etc. as indicated for precast manhole.

2.11 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.

   a. Flexible or rigid couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping: Use any of the following pipe materials for each size range:
1. PVC sewer pipe and fittings; gaskets; and gasketed joints..
2. Ductile-iron pressure pipe, ductile-iron standard or compact fittings, gaskets, and gasketed joints.
3. PVC pressure, PVC pressure fittings, gaskets, and gasketed joints.

D. Force-Main Pressure Piping: Use any of the following pipe materials for each size range:

1. PVC Schedule 80, water-service pipe; PVC Schedule 80, water-service-pipe fittings; and solvent-cemented joints.
2. Ductile-iron pressure pipe; ductile-iron standard or compact fittings; gaskets; and gasketed joints.
3. PVC pressure pipe, PVC pressure fittings, gaskets, and gasketed joints.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at slope indicated.
2. Install piping with restrained joints at tee fittings and at changes in direction for pressure pipe. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with cover indicated.
4. Notify engineer of clearance problems that would result in changes to grade and alignment.
5. Install ductile-iron culvert piping according to ASTM A 716.
6. Install ductile-iron and special fittings according to AWWA C600 or AWWA M41.
7. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
8. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

G. Install force-main pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
2. Install piping with line and grade as indicated or below frost line if not inidcated.
3. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
4. Install ductile-iron special fittings according to AWWA C600.
5. Install PVC pressure piping according to AWWA M23 or ASTM D 2774 and ASTM F 1668.
6. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.

3.4 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure drainage piping according to the following:
1. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.

2. Join ductile-iron and special fittings according to AWWA C600 or AWWA M41.
3. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cement joints.
4. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
5. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
6. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.

C. Join force-main pressure piping according to the following:

1. Join ductile-iron pressure piping according to AWWA C660 or AWWA M41 for push-on joints.
2. Join ductile-iron special fittings according to AWWA C660 or AWWA M41 for push-on joints.
3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
4. Join PVC water-service piping according to ASTM D 2855 for solvent-cemented joints.

D. Join dissimilar pipe materials with pressure-type couplings.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use same pipe type as sewer line that the cleanout is connected to. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use extra-heavy-duty, top-loading classification cleanouts in roads areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 12 inches around outside of cover. At contractors option, a square block can be used that is at least 12-inches wider that the cover. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.6 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections according to ASTM C 891.

C. Construct cast-in-place manhole bases as indicated.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

3.7 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary sewer system.

B. Connect force-main pressure piping to building's force mains where indicated.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.9 CLOSING ABANDONED SEWER DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section "Earth Moving."

3.10 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.

2. Defects requiring correction include the following:

   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.
   f. Test for infiltration or exfiltration between manholes as follows:
      1) Clean section of sewer line of dirt. Debris, gravel, rocks and other items.
      2) Fill section between manholes with water. Allow water to sit in pipe for not less than 3-hours to acclimate to surrounding earth temperature.
      3) Use a water pump to pressurize the sewer pipe section to not less than 5 psi and not more than 10 psi. Record starting pressure.
      4) Turn off water pressure and wait 20 minutes.
      5) Refill pipe to same pressure as in step 3 and measure volume required to fill pipe to same pressure.
      6) Pipe section passes test if volume required to refill pipe is less than ½-gallon per 400 feet of 8-inch pipe. Prorate the allowable seepage larger or smaller pipes and for shorter or longer distances.
      7) Find and fix leaks in any section that fails to pass test. Fix any visible leaks found even if section of pipe passes test.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   4. Submit separate report for each test.

C. Test pressure piping to same standard as water pipes in section 331100.
   1. Leaks and loss in test pressure constitute defects that must be repaired.
   2. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.12 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 221313

SECTION 221410 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water Piping.

B. Soil, Waste and Vent Piping.

C. Storm Water Piping.

D. Testing.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Materials and Methods.

B. Section 230540 - Mechanical Sound and Vibration Control.

C. Section 230548 - Mechanical Seismic Control.

D. Section 230700 - Mechanical Insulation.

E. Section 211010 - Outside Fire Protection System.

F. Section 221411 - Disinfecting Water Supply System.

G. Section 221430 - Plumbing Specialties.

H. Section 224440 – Plumbing Fixtures.

I. Section 224450 – Plumbing Equipment.

1.4 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Water Piping, Fittings, and Joints.

1.5 SEQUENCING/SCHEDULING

A. Coordinate any system shutdown with Campus Project Manager not less than 7 days prior to proposed shutdown.

PART 2 - PRODUCTS

2.1 WATER PIPE, TUBE, FITTINGS AND JOINTS

A. Exterior Buried:

1. Copper Tube, Fittings, and Joint Material:

a. Copper tube ASTM B88 Type K shall be soldered to wrought or cast fittings using 95-5 class SnSb (Tin-antimony) solder.
b. Wrought copper and bronze solder joint fittings shall conform to ANSI B16.22.
c. Cast bronze solder joint fittings shall conform to ANSI B16.18.

2. Cast Iron Pipe Fittings and Joints:

a. Gray cast iron pipe, centrifugally cast, 18/40 physicals, cement lined, mechanical joint, thickness class 23 minimum. 300 psi minimum working pressure "laying condition A" as designated by USA Standard A21.1 and 8 foot bury.
b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.
c. Mechanical joint fittings shall be Ductile Iron, 350 psi working pressure up to 24" size.

3. Ductile Iron Pipe Fittings and Joints:

a. Class 150, ductile iron pipe centrifugally cast, thickness class 2, cement lined, mechanical joint, 350 psi minimum working pressure "laying condition A" as designated by USA Standard A21.51 and 8 foot bury.
b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.

B. Interior Buried:

1. Provide type K annealed (soft) copper water tube conforming to ASTM B-88 with 95% tin 5% antimony solder joints using wrought fittings. No joints below grade. Provide continuous tube for all buried tubing using tube bends in lieu of fittings. Exterior tube may be coupled where requirements are in excess of standard mill lengths by using wrought pressure couplings with stops and silver solder brazed Joints. Lengths coupled in this manner, where necessary and acceptable to the Engineer, will meet the intent of the no fitting requirement of this Specification. Interior buried tube shall meet the same criteria and requirements.

C. Interior Tube Supported by Hangers and Clamps:

1. Provide ASTM B88 Type L hard drawn copper tube for all water distribution piping inside building/structure, with wrought copper fittings and couplers up to 6", cast brass or bronze fittings and couplers for sizes 6" and larger. Joints shall be 95-5 Class SnSb solder or Victaulic CTS roll-grooved couplers and fittings for 3" and larger tube.

2.2 SOIL DRAIN WASTE, VENT AND STORM PIPE FITTINGS AND JOINTS

A. General:

1. Cast iron pipe centrifugally cast service weight (SV) soil pipe with cast iron drainage fittings conforming to ASTM A 74. Joint materials and systems may be hub and spigot with neoprene gaskets and lubricant conforming to ASA-021 and ASTM C-564 SV pattern. Gaskets shall be equal to U.S. Pipe Company Veri-tite conforming to ASTM-C564 and/or CISPI HSN75 and be certified in writing to the Engineer that the following criteria has been met, thru testing by a recognized independent testing laboratory. Cast iron hubless pipe and fittings conforming to ASTM A 888 or CISPI 301. Hubless couplings shall conform to ASTM C 1277 for standard and ASTM C 1540 for heavy duty or CISPI 310.

   Criteria: Sizes 2" thru 6" shall withstand 15 psig hydrostatic pressure for 10 minutes with unrestrained joints, and no leakage, and using restrained joints must be able to withstand 25 psig air pressure and 40 psig hydrostatic pressure with no leakage. Offset joints shall withstand 1056 pounds of horizontal force without joint separation or detectable leakage.

B. Buried Pipe:

1. Provide SV hub and spigot cast iron pipe and fittings to 5'-0" beyond building excavation line, continue past this point with SV cast iron or XS vitrified clay to termination points with hub and spigot joints. At Contractor's option and where approved by local jurisdiction, No-Hub standard weight cast iron pipe with either M-G couplings or heavy-duty stainless steel shielded couplings may be used in lieu of hub and spigot with Ty-Seal neoprene gaskets. The heavy-duty shielded couplings shall comply with ASTM C1540, with ASTM C564 neoprene gaskets, minimum 0.008" stainless steel shields with transverse corrugations across longitudinal corrugations, standard 304 stainless steel clamps and 305 stainless steel screws. Entire assembly shall be suitable for direct burial, be corrosion resistant, and accommodate pipe deflection.

C. Interior Pipe Supported By Hangers and Clamps:

1. Provide S.V. cast iron pipe No Hub System using hubless cast iron soil pipe couplings certified to withstand a minimum of 50 psi internal pressure. Where stack pressures may theoretically exceed 50 psi, use clamp all or heavy-duty couplings with restrained joints horizontal and vertical up to 80 psig. For pressures above 80 psi, use Schedule 40 ASTM A-120 galvanized steel pipe with threaded cast iron drainage fittings. Roll grooved schedule 40 pipe with Victaulic Style 77M galvanized couplers may be used on horizontal and vertical stacks and mains. Use Teflon tape or compound for all threaded joint make-up.
2. Sump pump discharge from the pump to the point the waste stream flows continuously via gravity shall be Schedule 40 galvanized steel pipe with NPT threaded joints and fittings.

3. Copper Waste, Vent and Soil Pipe and Fittings shall be prohibited on this project.

2.3 SUBSURFACE AND FOOTING DRAINS

A. See Specification Section 334600 for requirements.

B. Provide polyvinylchloride perforated pipe (ASTM D2729) with PVC fittings and solvent weld joints. Provide four rows of ¼" dia. holes on three-inch staggered centers running parallel to the pipe axis. Rows shall be located 100 deg., 135 deg., 225 deg., & 260 deg. from vertical per Corps of Engineers VICKSBERY SPECIFICATION. Exceptions to hole size and locations will not be granted.

PART 3 - EXECUTION

3.1 WATER TUBE, FITTINGS AND JOINTS

A. General:

1. All copper tube and fittings shall be reamed and buffed prior to soldering or brazing.
2. The use of lead solder of any class, for joint make-up or back-up for finishing is prohibited.
3. Refer and conform to the Copper Development Association instructions for proper preparation and actual installation practice for all soldered and brazed joints.
4. Support water tube in accordance with Section 230529.
5. Pull tee (T-drill) fittings are forbidden.

3.2 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Repair or replace damaged installed products.

C. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

D. Remove construction debris from project site and legally dispose of debris.

3.3 PROTECTION

A. Protect installed work from damage due to subsequent construction activity on the site.

3.4 SOIL, DRAIN, WASTE, VENT AND STORM PIPE FITTINGS AND JOINTS

A. General:

1. Provide bedding, restraints and hangers as appropriate and in accordance with manufacturers recommendations based upon type of pipe, fittings, joints, and bury depth using final finished grading as the basis.

2. Piping shall be run true, plumb, and straight, with all restraints and hangers adjusted to carry their proportional load and locked to prevent pipe "wag" misalignment, movement or shear.
3. Provide anchors for piping risers on every floor using riser clamps, wall brackets, knee brackets, and foot blocks for all vertical piping over 20 feet straight height.
4. Furnish and install all soil, waste and vent piping for the complete sanitary system in accordance with jurisdictional code requirements.
5. All soil and waste piping shall be run at the following minimum slope unless otherwise indicated on drawings.

Slope of Horizontal Drainage Pipe	
Size (In.)	Min. Slope (In./Ft.)
2-1/2 or less	1/4
3 to 6	1/8
8 or larger	1/16

6. Bushings in soil waste or vent piping shall be prohibited. Tapped spigots or tees shall be used when changing from cast iron pipe to steel waste or vent piping, and for appropriate cleanout plugs.
7. Vertical Piping: All vertical soil and vent stacks shall be supported with riser clamps at each floor slab. When soil stacks over two stories in height terminate at the bottom on slab fill or native soil, provide stack base elbows set on 24" x 24" x 8" thick minimum poured reinforced concrete pads set directly on undisturbed native soil or fill compacted to same density as undisturbed earth.
8. Horizontal Piping (suspended):

    a. Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
    b. Cast iron soil pipe - Where joints occur, suspended cast iron soil pipe shall be supported at not more than five (5) foot intervals; except that pipe exceeding five (5) feet in length, may be supported at not more than ten (10) foot intervals. Supports shall be adequate to maintain alignment and prevent sagging and shall be placed within eighteen (18) inches of the hub or joint. Hubless or compression gasket joints must be supported at least at every other joint except that when the developed length between supports exceeds four (4) feet, they shall be provided at each joint. Supports shall also be provided at each horizontal branch connection. Supports shall be placed on or immediately adjacent to the coupling. Suspended lines shall be suitably braced to prevent horizontal movement.
    c. Threaded pipe - Threaded pipe (IPS), shall be supported in accordance with Section 230529.
    d. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for pipe sizes 4 inches and larger.
    e. For pipe sizes greater than 4 inches, axial restraints shall be provided for drain pipes at all changes in direction and at all changes in diameter greater than two pipe sizes.

9. The waste connections between fixtures and their respective collection and venting systems shall consist of galvanized steel nipples and cast iron drainage fittings.
10. All interior waste, soil, and vent piping up to 1-1/2" shall consist of galvanized steel with cast iron drainage fittings, all piping 1-1/2" and over shall consist of S.V. cast iron soil pipe and fittings.

11. All pipe and fittings shall have affixed thereon the CISPI grade mark of identification.
12. All vents shall be installed through the roof of at least the minimum size as required by jurisdictional code and shall be cast iron.
13. All vents protruding through the roof shall be not less than 2" size and extended to not less than 12 inches above the finished roof. Vents through built-up roofing shall be flashed with 24" x 24" x 4 lb. sheet lead. The flashing shall extend to top of vent and the edges turned down into a cast iron vent pipe. Single ply rubberized roofing systems shall be flashed around vent with top edge of roofing clamped to vent pipe and sealed with compatible sealant.
14. All vents shall be located in accordance with jurisdictional code and in no case less than two (2) feet from roof edge or parapet, or wall line of an "on the roof structure". Vent terminations shall not occur within twenty-five (25) feet of any outside air intake.
15. Provide all expansion joints, braces, earthquake restraints as required by the contract documents (Section 230548) and jurisdictional authority.

3.5 PROHIBITED PIPE ROUTING

A. Plumbing piping, regardless of contents (water, sewer, vent, etc.) shall <u>not</u> be routed through or above the following locations:

1. Electrical panel rooms
2. Electrical switch gear rooms
3. Electrical transformer rooms
4. Elevator shafts
5. Elevator equipment rooms
6. Data Centers
7. File Server Rooms / MDF / IDF

B. Should there be a conflict with the plans and the above paragraph, notify the Engineer immediately for corrective action prior to starting work.

3.6 TESTING

A. Schedule of Testing:

Service	Allowable Test Methods H_2O	CA	N_2	V	Minimum Test Pressure (psig)	Minimum Test Period (minutes)	Allowable Pressure Variance (psig)
1. Potable Water Pipe Valves & Fittings	X	 X			125 100	60 60	-0- +1/2
2. Sanitary, Storm & Acid Waste and Vent System:							
*Stack Height:							
0-23 FT.	X				10	30	-0-
24-34 FT.	X				15	30	-0-
35-46 FT.	X				20	20	-0-
47-57 FT.	X				25	20	-0-
58-69 FT.	X				30	10	-0-
70-80 FT.	X				35	10	-0-

Service	Allowable Test Methods H_2O	CA	N_2	V	Minimum Test Pressure (psig)	Minimum Test Period (minutes)	Allowable Pressure Variance (psig)
81-92 FT.	X				40	10	-0-
93-103 FT.	X				45	10	-0-
Over 104 FT.	X				50	10	-0-

B. Testing connections for hydrostatic tests shall be made at the base of the system, CA, N2 and vacuum testing can be made from connections anywhere in the system tested.

C. In the event that tests fail, use a standard soap and brush inspection using "Trouble Bubble" Liquid high density soap as manufactured by Jersey Meter Co., Patterson N.J. Formula ST-1. After source of failure is discovered, correct and retest system. Repeat procedure until system sustains required testing successfully.

D. Testing contractor shall give at least 16 working hours notice to the General Contractor/Construction Manager so that arrangements for witnessing tests can be made. The General Contractor/Construction Manager shall witness and SIGN the required test form.

E. All joints, valves, fittings and piping accessory items shall be exposed to view during tests whether pipe is above or below ground. "Closed in" or "Buried" piping shall be re-exposed during testing.

F. Proper restraining of piping and test plugs shall be accomplished prior to test.

END OF SECTION 221410

SECTION 221411 - DISINFECTING WATER SUPPLY SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Disinfection of Domestic Water Supply System.

1.2 RELATED WORK

A. Requirements: Provide Disinfecting Water Supply System in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 221410 - Plumbing Piping.

1.3 DEFINITIONS

A. Disinfectant residual means the quantity of disinfectant in treated water.

B. pH factor means the measure of alkalinity and acidity in water.

C. ppm means parts per million.

1.4 CONTRACTOR'S QUALIFICATIONS

A. Water Treatment Contractor: At least three years experience performing work specified herein.

B. Bacteriological Laboratory: Certified by Serving Water Board or District and be in compliance with the State and U.S. Safe Drinking Water Act.

1.5 REGULATORY AGENCY REQUIREMENTS

A. Comply with requirements of Local and State Regulations.

1.6 SUBMITTALS

A. Submit for review and acceptance the following items under provisions of the General Conditions of the Contract:

1. Water treatment contractor's evidence of experience.
2. Bacteriological laboratory's evidence of certification.

B. Submit printed data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Disinfection Report:

a. Include the following:

Date issued.

Project name and location.

Treatment Contractor's name, address, and phone number.

Type and form of disinfectant used.

Time and date of disinfectant injection start.

Time and date of disinfectant injection completion.

Test locations.

Initial and 24 hour disinfectant residuals in ppm for each outlet tested.

Time and date of flushing start.

Time and date of flushing completion.

Disinfectant residual after flushing in ppm for each outlet tested.

2. Bacteriological Report:

a. Include the following:

Date issued.

Project name and location.

Laboratory's name, certification number, address and phone number.

Time and date of water sample collection.

Name of person collecting samples.

Test locations.

Time and date of laboratory test start.

Coliform bacteria test results for each Outlet tested. Certification that water conforms or fails to conform to bacterial standards of State and Federal Safe Drinking Water Act.

Bacteriologist's signature.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect against damage and discoloration.

B. Maintain caution labels on hazardous materials.

C. Maintain storage room dry and with temperatures as uniform as possible between 60 deg.F and 80 deg.F.

D. Do not store Caustic Soda directly on floor colder than 55 deg.F.

1.8 PROTECTING WORK OF OTHER TRADES

A. Provide necessary signs, barricades, and notices to prevent any person from accidentally consuming water or disturbing system being treated.

B. Protect against damage and discoloration caused by work of this Section.

PART 2 - PRODUCTS

2.1 DISINFECTANT

A. Free chlorine; liquid, powder, tablet, or gas.

2.2 ALKALI

A. Caustic Soda or Soda Ash.

2.3 ACID

A. Hydrochloric type.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

A. Prior to starting work, verify that Domestic Water System is completed, flushed and clean.

B. Prior to starting work, notify Construction Manager/General Contractor of any defects requiring correction.

C. Do not start work until conditions are satisfactory.

3.2 PREPARATION OF WATER FOR TREATMENT

A. Verify pH factor of water to be treated.

B. If pH factor is less than 7.4, introduce sufficient alkali during disinfectant injection to produce 7.4 to 7.6 pH level.

C. If pH factor is greater than 7.6, introduce sufficient acid during disinfectant injection to lower pH to 7.4 to 7.6 level.

3.3 SYSTEM TREATMENT

A. Inject disinfectant throughout system to obtain 50 to 80 ppm residual.

B. Starting at outlet closest to water sources, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.

C. Test for disinfectant residual at each of the following locations:

1. Ends of piping runs.
2. Remote outlets. (Ends of each multiple fixture branch line)
3. Tanks and domestic water heaters.
4. At least 15% of outlets on each floor as directed by Architect/Engineer.

D. Maintain disinfectant in system for 24 hours.

E. If resultant disinfectant residual test is less than 25 ppm, repeat System Treatment.

3.4 FLUSHING

A. Flush disinfectant from entire system; permit no more than residual rate of supplied incoming water.

3.5 BACTERIOLOGICAL TEST

A. Instruct Bacteriological Laboratory to take water samples no sooner than 24 hours after flushing system.

B. Take water samples at each of the following locations:

1. Where water enters system.
2. Ends of piping runs.
3. Remote outlets.
4. Tanks.
5. At least 10% of outlets on each floor other than those used for testing disinfectant residual, where directed by Architect/Engineer, but in no case less than 2 outlets per floor.

C. Analyze Water Samples in accordance with Standard Methods for the examination of Water & Waste Water, published by American Water Works Assoc., 6666 W. Quincy Ave., Denver, CO 80235.

D. If Bacteriological Test proves water quality to be unacceptable, repeat System Treatment.

3.6 PRODUCT CLEANING & REPAIRING

A. Including work of other trades, clean, repair and touch-up, or replace when directed, products which have been soiled, discolored, or damaged by work of this Section.

B. Remove debris from Project Site upon work completion or sooner, if directed.

END OF SECTION 221411

SECTION 221430 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Drains and drainage products.
B. Downspout nozzle.
C. Storm drain expansion joints.
D. Cleanouts.
E. Safe pans and drain flashings.
F. Sillcocks, yard hydrants, hose bibbs and hose stations.
G. Pressure gauges, thermometers, and test plugs.
H. Shock arrestors.
I. Backflow preventers.
J. Pressure reducing valves.
K. Pressure and temperature relief valves.
L. Washer and dryer wall boxes.
M. Trap chargers and accessories.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish electrical outlets installed in Washer Wall Box for Division 26 power wiring installation.

1.3 RELATED WORK

A. Requirements: Provide Plumbing Specialties in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

1.4 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Floor Drains (FD)
2. Floor Sinks (FS)
3. Roof Drains (RD)
4. Overflow Drains (OD)
5. Downspout Nozzles (DSN)
6. Sillcocks (SC), Ground Hydrants (GH) and Yard Hydrants (YH)
7. Hose bibbs (HB) and Hose Stations (HV)
8. Pressure gauges (PG)
9. Thermometers (T)
10. Shock Arrestors (SA)

11. Backflow Preventer (BP)
12. Pressure Reducing Valve (PRV)
13. Washer Wall Box (WWB)
14. Dryer Vent Wall Box (DVWB)
15. Trap Primers (TP)

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Backflow Preventer (BP)
2. Pressure Reducing Valve (PRV)

1.5 WARRANTIES

A. Provide original copies of all warranties for specific equipment where specified and in accordance with Section 230500.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Where acceptable manufacturers are listed, these manufacturers must submit products that are in fact equivalent in all respects of materials, design, function, and appearance to the manufacturer listed as the base manufacturer in the specification body or drawing schedules. Deviations of any type will not be acceptable.

B. Where other acceptable manufacturers are not listed, only the base manufacturer will be accepted.

C. All items of like nomenclature shall be supplied by one manufacturer only.

2.2 FLOOR DRAINS (FD)

A. Acceptable manufacturers: Wade series 1100, JR Smith series 2005, Josam series 30000, Zurn series Z-415, Watts FD-100 series.

B. Schedule: See Drawings.

2.3 FLOOR DRAINS, HEAVY DUTY

A. Acceptable manufacturers: Wade series 1240, JR Smith series 2330, Josam series 31200, Zurn series Z-512, Watts FD-340 series, MIFAB series F-1340C.

B. Schedule: See Drawings.

2.4 FLOOR SINKS (FS)

A. Acceptable manufacturers: Wade series 9110/9140, JR Smith series 3100/3150, Josam series 49000/49040, Zurn series Z-1900/Z-1910, Watts FD-860 series, MIFAB series FS-1520/FS-1730.

B. Schedule: See Drawings.

2.5 ROOF DRAINS

A. Acceptable manufacturers: Wade series 3000/3200, JR Smith series 1010/1330, Josam series 21500/22080, Zurn series Z-100/Z-125, Watts RD-300/200 series, MIFAB series R-1200.

B. Schedule: See Drawings.

2.6 OVERFLOW DRAIN

A. Acceptable manufacturers: Wade series 3000/3200, JR Smith series 1010/1330, Josam series 21500/22080, Zurn series Z-100/Z-125, Watts RD-300/200 series, MIFAB series R-1200-R.

B. Schedule: See Drawings.

2.7 DOWNSPOUT NOZZLES

A. Acceptable manufacturers: Wade series 3940, JR Smith series 1770, Josam series 25010, Zurn series Z-199, Watts RD-940 series, MIFAB series R-1940.

B. Schedule: See Drawings.

2.8 EXPANSION JOINTS

A. Acceptable manufacturers: Wade series 3900, JR Smith series 1710, Josam series 26200, Zurn series Z-190, Watts RD-900 series, Metraflex, MIFAB series R-1900, Hyspan.

B. Schedule:

Plan Code	EJ
Material	Cast Iron
Sleeve	Bronze/Brass
Gasket	Neoprene or Graphite
Size	2”-10”

2.9 FLOOR CLEANOUTS

A. Acceptable manufacturers: Wade series 6000, JR Smith series 4020/4100/4200, Josam series 56000, Zurn series Z-1400, Watts CO-200-R/200-RX/200-US series, MIFAB series C1100-R/C1100-XR/C1100-UR.

B. Cast iron adjustable body, ABS plug, vandal-proof security screws.

1. Provide flange and flashing clamp for Cleanouts in areas with waterproof membrane and all cleanouts above slab-on-grade.
2. Provide nickel bronze top to match floor finish as indicated in the Architectural finish schedule. Provide heavy duty nickel bronze top for cleanouts in storage rooms, kitchens, and similar areas. Provide heavy duty cast iron or ductile iron top for cleanouts in equipment rooms, traffic areas, parking areas, and similar unfinished areas.

2.10 WALL CLEANOUTS

A. Acceptable manufacturers: Wade series 8560 with 8480R, JR Smith series 4530, Josam series 58790, Zurn series 1446, Watts CO-460-RD series, MIFAB series C-1460.

B. Cast iron clean out tee, ABS plug, vandal proof security screws, stainless steel cover with screw.

2.11 GRADE CLEANOUTS

A. Acceptable manufacturers: Wade series 8300 MF with 6000 spigot outlet, JR Smith series 4250, Josam series 58850, Zurn series Z-1474 with Z-1449, Watts CO-300 series, MIFAB series C-1300.

B. Heavy duty cast iron clean out housing, heavy duty cast iron or ductile iron cover, cast iron ferrule, ABS plug, vandal proof security screws.

1. Provide piping system identification cast into cover; "SAN" for sanitary waste cleanouts, "STORM" for storm drainage cleanouts.

2.12 VENT CAPS

A. Acceptable manufacturers: JR Smith series 1748, Josam series 26700, Zurn series Z-193, Watts RD-680 series, MIFAB series R-1930.

B. Galvanized iron body and dome, vandal proof screws.

2.13 SAFE PANS AND DRAIN FLASHINGS

A. Provide one of following systems:

1. 4 lb./sq.ft. sheet lead with 15 lb. asphaltic felt sub pan (underliner).
2. #24 B&S gauge (0.021") minimum sheet copper with l5 lb. asphaltic felt sub pan (underliner).
3. 0.040" non-plasticized chlorinated polyethylene sheet with 30 lb. felt underliner.

4. 3 ply 15 mil polyvinylchloride sheet with 30 lb. felt underliner.

2.14 WATER HEATER SAFETY PAN (WHSP)

A. Provide Shamrock Industries Inc. or equivalent gray polyethylene pan 2" larger than heater on all sides and minimum 1-1/2” deep with side or bottom drain fitting on electric water heaters installed above ceilings, under counters or on wood flooring.

B. Provide Ruud Mfg. Co. "Heater Pan", Canplas or equivalent spun aluminum pan 2” larger than heater on all sides and minimum 1-1/2” deep with side or bottom drain fitting on gas fired water heaters installed on combustible foundations with 3/4" thick fire proof liner between pan and combustible construction.

2.15 SILLCOCK, EXPOSED, NON-FREEZE

A. Acceptable manufacturers: Woodford series 65, JR Smith series 5609, Josam series 71050, Zurn series Z-1310, Wade series 8600, Watts HY-420 series.

B. Schedule: See Drawings.

2.16 HOSE BIBBS

A. Acceptable manufacturers: As listed in schedule.

B. Schedule: See Drawings.

2.17 STATIONARY PRESSURE GAUGES

A. Acceptable manufacturers: Trerice 600C Series, Weksler Regal Series, Weiss Instruments.

B. Schedule:

Plan Code	PG-1	PG-2
Type	4-1/2” Dial	4-1/2” Dial
Bourbon Tube/Socket	Phosphor Bronze Tube Brass Socket	Stainless Steel Tube 316 Stainless Steel Socket
Accuracy	ANSI B40.1 Grade 1A 1% F.S. over middle half of range	ANSI B40.1 Grade 1A 1% F.S. over middle half of range
Case	Cast Aluminum	Cast Aluminum
Window	Clear Glass	Clear Glass
Snubber	Yes	Yes
Coil Syphon	For Steam Service	For Steam Service
Gauge Cock	Yes	Yes
Set Hand	No	No
Silicone Filled	No	No
Weatherproof	No	No

C. Range: Select gauges for the following standard ranges unless otherwise indicated on drawings, or as required for special systems.

1. Domestic Water 0 to +160 psi
2. Pump Gauges -30 in Hg to +100 psi

2.18 STATIONARY THERMOMETERS

A. Acceptable manufacturers: Trerice Industrial Series, Ametek Industrial Series, Weiss Instruments, Miljoco, Weksler.

B. Schedule:

Plan code:	T-1
Type	Adjustable angle
Case	9" cast aluminum
Window	Clear acrylic
Tube	Thermistor
Stem	Aluminum, insertable
Separable Socket	Brass

C. Range: Select thermometers, for the following standard ranges unless otherwise indicated on Drawings, or as required for special systems.

1. Heat Pump Water 0 to 150 °F
2. Domestic cold water 0 to 100 °F
3. Domestic hot water 30 to 240 °F

2.19 TEMPERATURE AND PRESSURE TEST PLUGS (T&PTP)

A. Manufacturer: Trerice, Fairfax, Flow Design, Peterson Equipment, Weksler, Pete's Plug.

B. Plugs suitable for vacuum to 600 psig and temperatures of -20 deg.F to 300 deg.F with cap and extension for insulated pipe where required.

C. Provide one pressure gauge, gauge adapter, and two thermometers in shock-proof case.

D. Schedule:

PLAN CODE:	MAKE:	MODEL:	PRESSURE & TEMPERATURE TEST KIT
T&PTP	Trerice	D3741	Trerice D3750 (0-100 psig)

2.20 SHOCK ARRESTORS FOR WATER (SA)

A. Manufacturer: Precision Plumbing Products Co., Wade Shokstop, J.R. Smith series 5000, Josam series 75000, Zurn Z-1700, Watts SS series.

B. Schedule:

PLAN CODE	"P.D.I." SIZE	FIXTURE UNITS
SA-A	A	1-11
SA-B	B	12-32
SA-C	C	33-60
SA-D	D	61-113
SA-E	E	114-154
SA-F	F	155-330

2.21 REDUCED PRESSURE BACKFLOW PREVENTER

A. Acceptable manufacturers: Conbraco Series 40-200, Watts series 009 and 909, Febco series 825Y, Hersey series FRP-II.

B. Bronze body, independent spring loaded check valves, diaphragm type differential pressure relief valve, shut-off ball valves, strainer, test cocks. Suitable for water temperature range of 33-140 °F.

C. Approved under ASSE 1013 and AWWA C511.

D. Backflow preventer test kit: Provide complete test kit including pressure gauge, test valves, high pressure hoses, adaptor fittings, mounting strap, and instructions, in a corrosion resistant carrying case.

2.22 PRESSURE REDUCING VALVE (PRV)

A. Acceptable manufacturers: Watts series N223B, Conbraco, Hoffman.

B. 300 psi bronze body, replaceable seat, strainer, adjustable outlet pressure, thermal expansion by-pass. Suitable for water temperature up to 160 °F.

C. Approved under ASSE 1003 and IAPMO.

2.23 TEMPERATURE AND PRESSURE RELIEF VALVES (T&P)

A. Acceptable Manufacturers: Kunkle, Watts, Conbraco, McDonnell and Miller.
B. Schedule:

TYPES	SIZE	MAKE	MODEL	SERVICE	MAX PRESS	ASME MAX TEMP	ASME RATING BTUH MAX.
T & P	3/4"	Kunkle	137	Water Pressure Vessel	125 psig	250 F	2,230,000
Press	3/4"	Kunkle	84-45	Air	125 psig	300 F	NA
Vac	3/4"	Kunkle	80-45	Vacuum	15" Hg	300 F	NA
T & P	3/4"	Watts	40XL8	Water Heater	125 psig	210 F	777,600

2.24 AUTOMATIC CLOTHES WASHER SUPPLY AND DRAIN BOX (WWB)

A. Acceptable Manufacturers: Guy Gray, Symmons, Watts Regulator.

B. Schedule: See Drawings.

2.25 TRAP CHARGERS AND ACCESSORIES (No Plan Code)

A. Manufacturer: Precision Plumbing Products, Co. ("P.P.P.")

B. Pressure Activated Trap Primers:

1. Schedule: See Drawings.

2.26 DRYER VENT WALL BOX (DVWB)

A. Manufacturer: Guy Gray.

B. Schedule: See Drawings.

PART 3 - EXECUTION

3.1 DRAINS

A. Coordinate drain placement with Contractor for Division 3 - Concrete.

B. Drain, strainer, and grate finishes shall be as specified, cover all finished surfaces during construction to prevent damage.

C. Install drains with "P" pattern traps and vents as required.

D. All drain bodies shall be plugged during construction to prevent foreign objects, dirt, concrete, etc. from entering the drain and drainage piping.

E. Planter drains shall not receive domes until final landscaping is accomplished. Provide closure plugs until landscaping and dome installation is furnished.

F. Drains shall be set flush and level with finished surfaces, with grate pattern parallel or perpendicular to adjacent walls or floor patterns.

G. Flash all drains on roofs, upper floors, and floor over crawl spaces with 24"x24" minimum flashing pans. Shower pans shall be turned up in walls to a minimum of 6" above the shower receptor threshold.

H. Clean and polish all drain bowls, rims, strainers, and grates prior to final inspection.

3.2 CLEANOUTS

A. Provide cleanouts in waste, soil, and storm piping at each change in direction greater than 45°, as required by Jurisdictional Code.

B. Provide cleanouts at 50 feet on center for all interior sanitary and storm piping, and at each base of waste, soil or storm pipe stack or drop, 100 feet on center for all exterior sanitary and storm piping or as required by jurisdictional code.

B. Provide appropriate access tops for imposed construction.

C. Coordinate interior floor cleanout locations with contractor for Division 3 - Concrete.

D. Cleanouts to be provided with ABS or Delrin plugs. Lead sealed, brass, or cast iron plugs will not be acceptable unless specifically required by jurisdictional code authority.

E. Provide 24"x24" minimum flashing pans and clamp devices for all cleanouts located on upper floors or floors over crawl spaces.

F. Where cleanout arms extend horizontally and/or vertically more than 15 feet from the sewer main which they are serving, provide 2" minimum vent off the end of the arm and connect to the building vent system.

G. Clean and polish all cleanout access covers prior to final inspection.

H. Cleanout access covers shall be flush and level with finished building surfaces.

I. Install cleanout plugs on exposed or accessible piping. Plugs shall be line size up to 3" and over 8", 4" plugs for sizes 4" thru 8".

J. Provide wall cleanouts where piping is concealed in walls or non-accessible chases, use tapped cleanout tee or tapped extension to within 4" of wall face. Do not use no-hub type blind plugs for wall cleanouts.

K. Provide 12"x12"x8" thick 3000 lb. concrete pads for all grade cleanouts. Concrete shall be in accordance with Division 3 - Concrete. Tops of pads to be 1" above finish grade and cleanout access flush and level and centered in pad surface.

3.3 DOWNSPOUT NOZZLES (DSN)

A. Terminate storm and overflow drains into full size nickel bronze downspout nozzles, seal annular space between wall opening and pipe with silicone seal, anchor nozzle wall flange with three 1/4" flat head machine bolts and lead expanders. Set DSN a minimum of 6" and a maximum of 12" above the splash block surface, unless otherwise noted.

B. Install drain pipe to thread adaptors and threaded galvanized schedule 40 nipples or short pipe through exterior wall for threading on the DSN. T.O.E. nipples or short pipe may be used for "NO-HUB" system where galvanized and drain pipe are joined by an approved No Hub coupling adaptor. Anchor pipe to building immediately downstream of adaptor.

C. Coordinate required location of standard splash blocks at all DSN locations for Construction Manager/General Contractor.

3.4 STORM DRAIN EXPANSION JOINTS (EJ)

A. Install vertical expansion joints at the roof drain outlet for all drains having straight vertical run directly from the drain of 10 feet or more.

B. Install special horizontal expansion joints at center of runs for horizontal storm piping having one hundred feet of straight run. Anchor ends of run. Provide expansion joints where storm drains cross a building expansion joint. Anchor both sides of building joint or provide adequate swing joints with appropriate anchors.

3.5 SANITARY VENT CAPS

A. Install where shown on drawings, vandal resistant vent caps a minimum of 14" above the roof surface.

B. Provide 24"x24"x4 lb. sheet lead flashing up 12" above roof to vent flashing collar.

C. Secure dome and entire assembly tight to pipe.

3.6 SAFE PANS AND DRAIN FLASHINGS (no plan code)

A. Provide safe pans for all shower bases, shower rooms, wet rooms and kitchen areas. Pans shall extend wall to wall and turn up at least 6" above finish floor level or receptor rims into wall construction. Pans shall be laid over non-puncturing base such as heavy asphaltic felt, fine sand that bears no silica, or other acceptable material.

B. All drains on upper floors or over crawl spaces shall be flashed with flashing extending a minimum of 12" beyond the drain top dimensions.

C. Seams to be folded and shaped as required:

1. Solder lead seams.
2. Solder sheet copper seams with 50/50 (50% tin, 50% lead) or 45/55 (45% tin, 55% lead) commercial grade solder.
3. Solvent weld PVC and un-plasticized chlorinated polyethylene seams.

3.7 WATER HEATER SAFETY PAN (WHSP)

A. Install safety pans for all electric water heaters installed above ceilings, under counters or on wood flooring. Route drain to floor sink/drain with indirect connection.

B. Install safety pans for all gas fired water heaters installed on combustible foundations or where leakage will cause damage. Route drain to floor sink/drain with indirect connection.

C. Provide structural supports, air gapped pan drains, drain extensions and pan drain connections as required.

3.8 SILLCOCKS (SC)

A. Provide sillcocks at 100 feet maximum spacing around building perimeter, and at other locations shown on Drawings.

B. Provide all sillcocks with accessible stop and drain valves in heated areas, provide access panels where required.

C. Provide flush or surface mounting, square and plumb to building walls, with supply tube pitched for complete drainout.

D. Anchor all sillcocks with anchor flange provided by manufacturer.

E. Caulk annular space between walls and sillcock and sillcock piping with non-hardening silicone base sealant.

F. Mount sillcocks at 24" above finished grade or surfacing.

G. Where mounting heights other than 24" are shown on the Drawings, the Drawings shall supercede the Specifications.

H. Vacuum breakers to be non-removable.

I. Clean all surfaces including faceplate, box, access door, cam lock and interior of box prior to final inspection.

J. Sillcocks shall not be operated by hand tools, provide 2 keys per sillcock. Units found to be marred due to hand tool operation or other causes, shall be replaced at no increase to the Contract Sum.

K. Clean and polish entire sillcock prior to final inspection.

3.9 HOSE BIBBS (HB)

A. Provide hose bibbs in each equipment room, toilet room and kitchen area equipped with floor drainage systems and where shown on drawings, maximum spacing shall accommodate 50 feet of hose to any point within the drainage area measured around obstructions and equipment, in lieu of straight line measurement. Hose bibbs in toilet rooms mounted under standard lavatory, do not install near ADA lavatory where it could impede access.

B. Anchor hose bibb within wall for rigid flush flange mounting.

C. Install bibb true and plumb with wall flange flush to surface, caulk annular space between wall and flange.

D. Mounting height to be 18" above floor in toilet rooms and immediately under furthest lavatory from entry, 60" above floor in equipment rooms or as shown on drawings.

E. Hose bibbs shall not be operated with hand tools, use only tee handle, furnish one tee handle per bibb. Units found marred due to hand tool operation or other causes will be replaced at Contractors expense.

F. Clean and polish hose bibbs prior to final inspection.

3.10 STATIONARY PRESSURE GAUGES (PG)

A. Provide gauges for steam, water, air and vacuum systems, complete with gauge cocks and snubbers, where required by Drawings.

B. Install in semi or upright position, tilted so as to be readable from floor level.

C. Clean gauge, and glass, and calibrate by test prior to final inspection.

3.11 STATIONARY THERMOMETERS (T)

A. Install thermometers where indicated on Drawings in upright position with case tilted to be readable from floor level.

B. Clean case and glass prior to final inspection.

3.12 TEMPERATURE AND PRESSURE PLUGS (T&PTP)

A. Provide plugs where periodic temperature and/or pressure indication is required as shown on drawings. Provide 1/4" MPT tapping, cap and seal for plug and extension for insulated pipe as applicable.

3.13 SHOCK ARRESTORS FOR WATER (SA)

A. Provide shock arrestors in accordance with Plumbing Drainage Institute (PDI) Standard WH-201 and as shown on drawings.

B. Provide 8"x8" minimum access panels centered on each shock arrestor that is otherwise inaccessible.

C. Shock arrestors shall be mounted as close to the line or quick closing valve as possible. Remote mounting or excessive (over 6") nipple mounting will not be acceptable.

D. Gate valves installed at each shock arrestor will not generally be required. Furnish only where specifically shown on drawings.

E. Each shock absorber piston shall be exercised at least once prior to final installation. (Physically move the piston up into chamber from throat of unit. Use wooden push rod only in the performance of this exercise.)

3.14 REDUCED PRESSURE BACKFLOW PREVENTER (BP)

A. Provide reduced pressure type backflow preventers on all connections between the domestic water system and make-up supplies to any non potable system, i.e.: Heating, Boilers, Cooling Towers, Chiller, Evaporative Coolers, and the like.

B. Anchor backflow preventer in place.

C. Clean and test assembly in place in accordance with State Health Code.

D. Provide funnels and attach to unit per manufacturers instructions, in true, level and plumb position.

E. Provide IPS to solder adaptor to funnel outlet and run type M copper tubing in an unobtrusive manner routed to an approved drain receptor.

F. Hang and anchor drain tubing so as to be rigid and stable.

G. Permanently affix drain outlet at drain receptor so as to be rigid and unmovable.

3.15 PRESSURE REDUCING VALVE (PRV)

A. Provide unistrut or similar frame for mounting all components of the pressure reducing valve station.

B. Arrangement shall be as shown on Drawings including by-pass.

C. Provide drain valves both sides of station on headers on low points.

D. Provide unions, strainer, valves, petcocks, gauges, straps and other accessories as detailed on Drawings.

E. Set each pressure reducing valve using full system pressure and flow individually to outlet pressures specified.

F. All gauges shall be installed to be readable from floor level. Provide petcocks on each gauge connection.

3.16 TEMPERATURE AND PRESSURE RELIEF VALVES (T & P)

A. Provide temperature and pressure relief valves, with full size drains extended and air gapped to floor drains or approved receptor. Provide relief valves on all water heaters, pressure vessels and closed piping systems per ASME Standard.

3.17 TRAP CHARGERS AND ACCESSORIES

A. Provide trap primer valve, gooseneck connection, distribution boxes, distribution tubing, air gap or vacuum breaker, extension drains, and pattern traps with charger connections for all emergency floor drains.

B. Support and brace charger, distribution boxes, piping and connections as appropriate.

3.18 WASHER WALL BOXES (WWB) AND DRYER WALL BOX (DVWB)

A. Set level and plumb and at height required by furnished appliances.

B. Coordinate with Appliance Supplier.

C. Provide water, waste, and vents as required.

D. Provide shock arrestors on hot and cold supplies to box as close to box connections as possible - provide 8"x8" access panel to each shock arrestor.

END OF SECTION 221430

SECTION 224440 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plumbing Fixtures and Trim.

B. Plumbing Fixture Accessories.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 221410 - Plumbing Piping.

B. Section 221430 - Plumbing Specialties.

C. Section 224450 – Plumbing Equipment.

D. Section 230529 - Basic Mechanical Materials and Methods.

1.4 REFERENCES

A. Comply with the applicable provisions and recommendations of the following:

1. ANSI A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
2. ANSI A112.19.2 - Vitreous China Plumbing Fixtures.
3. ANSI A112.19.3 - Stainless Steel Plumbing Fixtures.

1.5 SYSTEM DESCRIPTION

A. Provide all plumbing fixtures, materials, labor, accurate rough-in setting, leveling and adjustments of all fixtures, trim and specialties.

1.6 QUALITY ASSURANCE

A. Qualification:

1. Provide fixtures trim and specialties in accordance with style, type, quality and function as established by the named manufacturer and model specified for each item.
2. Provide all installations in accordance with jurisdictional code and health authorities standards, restrictions and recommendations.
3. Provide all fixtures and trim using a single manufacturer where possible, deviation will be allowed only where specifications indicate otherwise.

1.7 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Fixtures.
2. Carriers.
3. P-Traps.
4. Disposers.
5. Faucets, showerheads, valves, cocks, supplies and stops.
6. Finishes, material and colors.
7. Fixture specialties.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Flush Valves, Faucets and Cocks.
2. Plumbing Fixtures
3. Specialties

1.8 WARRANTIES

A. Provide original copies of all warranties and extended warranties for specific equipment where specified and in accordance with Section 230500.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cast iron and vitreous china: Kohler - Eljer - American Standard – Crane - Zurn Toto.

B. Stainless steel sink 316, 18 gauge minimum: Elkay - Just - Haws - Kohler.

C. Molded Stone: Fiat - Florestone - Stern Williams - E.L. Mustee.

D. Terrazzo: Fiat - Florestone - Stern Williams - Bradley.

E. Fiberglass and Plastic: Kohler - Snyder - Owens Corning - Bradley - Aquarius - Fiat - E.L. Mustee - Fiberglass Systems - Lasco Hitech - Florestone - Sterling.

F. Dual Flush Water Closet Flush Valves: Sloan – Zurn.

G. Low Flow Urinals: Sloan – Zurn - Toto.

H. Electric Water Coolers: Elkay - Halsey Taylor - Cordley - Haws - Sunroc - Filtrine - Oasis - Acorn.

I. Specialty Drinking Fountains: Western - Haws - Filtrine - Halsey Taylor - Elkay - Oasis - Acorn.

J. Water Mixing Valves Thermostatic, or Pressure Balanced: Leonard - Symmons - Kohler - Powers - Lawler - Bradley.

K. Metering Faucets: Bradley - Symmons – Speakman - Zurn - Moen.

L. Flush Valves: Sloan Royal - Delany Flushboy – Zurn – AquaVantage – Moen (hands free) - Speakman.

1. All flush valves required “dirt grabber” flush valve filter field installed. See paragraph 2.23 in this section.

M. Toilet Seats: Olsonite - Beneke - Sperzel- Bemis - Church.

N. Garbage Disposers: Waste King - Insinkerator - Big Genie.

O. Traps, Stops, Supplies, Airgaps, Drains: Kohler - Eljer - American Standard - Bridgeport - Brasscraft - Dearborn - Sayco - Frost - Eastman - McGuire - Zurn.

P. Chair Carriers: Josam - J.R. Smith - Zurn - Wade - Mifab.

Q. Faucets: Kohler - Eljer - American Standard - Bradley - Valley - Elkay - Chicago - Delta - Cambridge Brass - Moen - Symmons - Speakman - T & S Brass - Zurn.

R. Sensor Faucets: Sloan – Zurn – Toto - Moen - Speakman - Bradley - T& S Brass.

2.2 WATER CLOSETS

A. Floor Set, Siphon Jet, Valve Operated, Water Saver, 12" rough with open front seat: See Drawings.

2.3 LAVATORIES

A. Wall Hung, Vitreous China, Carrier Mounted: See Drawings.

B. Counter Top Mounted Oval: See Drawings.

2.4 URINALS

A. Wall Hung, Carrier Mounted, Valve Operated Siphon Jet: See Drawings.

2.5 SERVICE SINKS

A. Molded Stone: See Drawings.

2.6 FAUCET

A. Wall mount hot/cold ¾ hose thread. See Drawings.

2.7 ELECTRIC WATER COOLERS

A. Wall Hung, Carrier Mounted, Two Level: See Drawings.

2.8 SINKS

A. Enameled Cast Iron Self Rim US. Brass "Valley" Faucet Trim: See Drawings.

B. Stainless Steel, Self Rim: See Drawings.

2.9 SHOWERS

A. Individual Concealed Pressure and Thermostatic Balancing Valve and Head. (Stall provided under Architectural Divisions of the Work.) See Drawings.

2.10 MASTER THERMOSTATIC MIXING VALVES

A. Cabinet mounted and exposed type master mixing valves: adjustable setpoint, thermostatic type, adjustable limit stops, ball valve shut-offs, inlet checkstops, outlet thermometer. Provide recessed locking stainless steel cabinet where indicated.

B. Provide valves of sizes and capacities scheduled on Drawings. Provide high-low manifold type where specified and where required to meet specified range of flow.

C. Leonard Type TM, Symmons Series 5, Bradley.

2.11 LAVATORY THERMOSTATIC MIXING VALVES

A. Adjustable high temperature limit stop (factory set for 110°F), thermostatic type, inlet checkstops. Provide recessed locking stainless steel cabinet where indicated.

B. Provide valves of sizes and capacities scheduled on Drawings.

C. Models:

1. Exposed: Leonard 210-SB, Symmons Series 5.
2. S.S. Cabinet: Leonard TA-254-STSTL, Symmons Series 5B, Bradley.

2.12 FIXTURE SUPPLIES & STOPS

A. Schedule:

Sink & Lavatory Supplies:		(1/4 turn chrome ball valve, stainless steel braided tube, 1/2” x 3/8”) (L.K. Stops, 12" Riser, 1/2 x 3/8)		
Make:	Brass Craft	Bridgeport	Frost	Dearborn
Model:	SCR 1912	1694 LK	7824-2LK	2712 KCW
DF & Lavatory Supplies:		(W.H. Stops, 12" Riser, 1/2" x 3/8")		
Make:	Brass Craft	Bridgeport	Frost	Dearborn
Model:	CR 1912	1694	7824-2	2712 SCW
Bidet & Sink Supplies:		(L.K. Stop, 20" Riser, 1/2" x 1/2")		
Make:	Brass Craft	Bridgeport	Frost	Dearborn
Model:	SCR 3920	1666 or 1786	8135-2/8218-2	None
Bidet & Sink Supplies:		(W.H. Stop, 20" Riser, 1/2" x 1/2")		
Make:	Brass Craft	Bridgeport	Frost	Dearborn
Model:	CR 3920A	1695 MOD	7816-2	None
Water Closet Tank Supplies:		(L.K.) Stop. 12" Riser, 1/2 x 3/8)		
Make:	Brass Craft	Bridgeport	Frost	Dearborn
Model:	SCR 1912 DL	1770 LK	7925-2LK	3112 KCW
Water Closet Tank Supplies:		(W.H. Stop, 12" Riser, 1/2 x 3/8)		
Make:	Brass Craft	Bridgeport	Frost	Dearborn
Model:	CR 1912 DL	1170	7925-2	3112 SCW

2.13 FLUSH VALVE FILTER

A. South Fork Manufacturing “Dirt Grabber” Flush Valve Filter #SFDG1, 801-953-3001.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examination: Examine the contract documents and provide all necessary attachments, accessories, support equipment and materials as necessary to fit allocated spaces.

3.2 PREPARATION

A. Field Measurements: Verify all dimensions and installation requirements so that work can be accurately fitted to other construction and in accordance with the intent of the contract documents. Be responsible for accuracy of measurements and adequate space requirements for the precise fitting and assembly of finished work.

3.3 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

A. Water Closets:

1. Floor Mounted

a. Floor mounted water closet flanges are to be solidly anchored to the floor with lag screws, or bolts and expanders as appropriate for floor construction.
b. Water closet bowls are to be rigidly anchored to the floor flanges.
c. Provide fixture bolt caps to match fixture color for all exposed fixture bolts and nuts.
d. Water closets and trim shall be set level and plumb. Insert copper shims under base of bowl if required to level unit.
e. Spacing of water closets shall be in accordance with contract documents and jurisdictional codes.
f. Flush valve serving water closets located within the handicap stalls shall be installed with the flush handle to the “open side” of the toilet stall (opposite of the grab bar side).

2. Water Closet Supplies

a. Supplies shall be roughed with "L" copper tube nipple through wall cut to exact length and finished with escutcheon, matching fixture trim finish.

3. Water Closet Seats

a. Secure seats to water closets and adjust self-sustaining check hinge to hold the seat at any raised position. Removable bumpers shall match seat color and be secured.

B. Lavatories:

1. Wall and Counter Mounted

a. Wall mounted lavatory carriers are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.
b. Carriers are to be furnished with a metal mounting plate and bearing plate.
c. Wall mounted lavatories are to be supported by concealed metal carriers. Transmitting fixture weight loads to the fixture pipe connection <u>is not acceptable</u>.
d. Wood or metal mounting plates anchored to the wall framing or studs will not be acceptable.
e. Carriers are to become part of the structure and the lavatories shall not exert any weight or stress on the interior wall.
f. Lavatories and trim shall be set level and plumb.
g. Spacing of lavatories shall be in accordance with contract documents and jurisdictional codes.

C. Urinals:

1. Wall Mounted

a. Wall mounted urinal carriers are to be rigidly anchored to the floor structure in accordance with manufacturer's installation instructions.
b. Wall mounted urinals are to be supported by concealed metal carriers. Transmitting fixture weight loads to the fixture pipe connection will not be acceptable.
c. Wood or metal mounting plates anchored to the wall framing or studs will not be acceptable.
d. Carriers are to become part of the structure and the urinals shall not exert any weight or stress on the interior wall.
e. Urinals and trim shall be set level and plumb.
f. Spacing of urinals shall be in accordance with contract documents and jurisdictional codes.
g. Install urinals in accordance with manufacturers installation instructions.

D. Service Sink:

1. Install service sink in accordance with manufacturers installation instructions.
2. Terrazzo service sinks shall be set on a minimum of 1/4" of silica free sand bedding shimmed with copper shims.
3. Wall mounted service sink trap standards are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.
4. Install mop hangers over service sinks, on wall adjacent and perpendicular to faucet mounting, so mops drain into sink.
5. Install hose brackets and attach hoses to service sink faucets.
6. Service sinks and trim shall be set level and plumb.

E. Faucets:

1. Mount faucet rigidly to wall.
2. Provide vacuum breaker at hose connection.

F. Electric Water Cooler:

1. Wall Mounted

a. Electric water cooler carriers are to be rigidly anchored to the floor structure in accordance with manufacturer's installation instructions.
b. Wall mounted electric water coolers are to be supported by concealed metal carriers. Transmitting fixture weight load to the fixture pipe connection will not be acceptable.
c. Wood or metal mounting plates anchored to studs or wall framing will not be acceptable.
d. Carriers are to become part of the structure and the electric water coolers shall not exert any weight or stress on the interior wall.

G. Sinks:

1. Each sink compartment shall be separately trapped and wasted to wall, continuous waste is not acceptable.

2. Undercounter dishwasher waste shall be provided with air gap fitting through sink backledge and waste to a dishwasher directional tee upstream of sink trap. Do not connect dishwasher to disposer tap inlet.
3. Furnish separate wheel handle angle or straight stops on dishwasher supplies.

H. Showers:

1. Stall Showers

a. Waste outlets for shower compartment receptors shall be a minimum of 3 inches in diameter with a removable strainer.
b. All shower stalls except those having metal enameled receptors, shall have a lead or copper shower pan or the equivalent thereof as determined in Section 221430.
c. The shower drain grate area shall be not less then 1-1/2 times the free area of the waste pipe.

I. Master Pressure and Thermostatic Mixing Valves:

1. Install master thermostatic mixing valves in accordance with manufacturers installation instructions. Limit maximum temperature to 110 deg. F. by setting temperature limit stop for handle.

J. Fixture Supplies and Stops:

1. Provide fixture supplies and stops on every individual fixture or appliance.
2. Stops shall be compression by compression types with flexible straight copper tube risers, loose key or wheel handles stops. Provide one key per fixture for all loose key (L.K.) stops.
3. All components, stops, risers, inlet pipe and escutcheon shall be chrome plated brass, polished stainless steel, or special finish as specified for fixture trim.
4. Supplies and stops shall be anchored rigidly behind walls, eliminating push or pull movement.

K. Escutcheon Plates:

1. Provide cast brass chrome plated single piece escutcheons for all penetrations of piping thru walls, floors, or ceilings in finished and unfinished areas.

L. Faucets and Flushometers:

1. Faucets and flushometers shall be anchored rigidly behind walls, eliminating any push or pull movement.

M. Caulking:

1. All wall and floor mounted fixtures shall be caulked with a non-hardening white or fixture color match for colored fixtures adhesive elastomeric sealant compound providing a watertight seal at the joint with the walls or floor.

3.4 ELECTRICAL COORDINATION

A. Coordination of electrical service for all electric water coolers, garbage disposal units and whirlpool tubs will be the responsibility of the Division 23 contractor in accordance with Section 230529.

3.5 FIXTURE CONNECTIONS

A. Provide supply and waste connections for fixtures in accordance with the following table of minimum sizes or larger as required by jurisdictional codes, or drawings.

Fixture Description:	Hot Water:	Cold Water:	Waste:	Vent:
Water Closet (WC)				
Flush Valve:	NA	1”	4”	2”
Water Closet (WC)				
Tank Operated:	NA	½”	4”	2”
Lavatory (L):	½”	½”	1-1/4”	1-1/4”
Urinal (U):				
Flush Valve:	NA	¾”	2”	1-1/2”
Service Sinks (SS):	½”	½”	3”	1-1/2”
Sink (S):	½”	½”	1-1/2”	1-1/2”
Drinking Fountain (DF):	NA	½”	1-1/4”	1-1/4”
Electric Water Cooler (EWC):	NA	½”	1-1/4”	1-1/4”
Shower (SH):	½”	½”	3”	1-1/2”

3.6 FAUCET OPERATING ROTATION

A. Standard 2 handle faucets shall rotate as follows:

1. Hot Water clockwise to "on", counter clockwise to "off".
2. Cold Water counter clockwise to "on", clockwise to "off".

B. Wrist blade handle faucets:

1. Initial setting at "off" (rest) position shall have handles parallel to the fixture apron or counter front.
2. Hot Water; Counter clockwise to full on (1/4 turn), clockwise to "off".
3. Cold Water; clockwise to full on (1/4 turn), counter clockwise to "off".

3.7 ADJUSTMENT AND CLEANING

A. Adjustment: Adjust all flush valves, faucets, metering devices, shower heads, gas, air and vacuum cocks, and bubblers for proper flow and action after flushing operations are accomplished.

B. Cleaning: Clean all fixtures, trim, accessories and attachments including strainers, traps, aerators, and valves.

3.8 FLUSH VALVE FILTER “DIRT GRABBER”

A. Plumbing contractor shall install a SFDG1 “Dirt Grabber” flush valve filter according to manufacturer’s installation instructions in each urinal or toilet diaphragm-type flush valve manufactured by Sloan, Zurn or Taiko prior to turning water into the flush valve, but after water lines have been flushed according to local code or engineering specifications. The filtering media shall contain openings no larger than 0.0092” and consist of a minimum of 2-3/4 square inches of filtering material.

All other flush valves must contain a filtering device similar to the “Dirt Grabber” to protect the seating area from foreign debris which may enter the flush valve with the water.

Note: The SFDG1 “Dirt Grabber” Flush Valve Filter is manufactured by:

South Fork Manufacturing
798 No. Sage Dr.
Morgan, Utah 84050
Phone: 801-953-3001
Fax: 801-829-4146

END OF SECTION 224440

SECTION 224450 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Storage Tanks

B. Water Softener

C. Solar Collectors

1.2 RELATED WORK

A. Requirements: Provide Plumbing Equipment in accordance with the Contract Documents.

Section 221410 - Plumbing Piping.
Section 221430 - Plumbing Specialties.
Section 224440 - Plumbing Fixtures
Section 230500 - Basic Mechanical Requirements.
Section 230529 - Basic Mechanical Materials and Methods.
Section 230540 - Mechanical Sound and Vibration Control.
Section 230548 - Mechanical Seismic Control.
Section 230593 - Testing, Adjusting and Balancing
Section 230700 - Mechanical Insulation
Section 230900 - Controls
Section 231123- Natural Gas Systems.
Section 232113 - HVAC Piping & Specialties
Section 232123 - HVAC Pumps
Section 235100 - Breechings, Chimneys, Stacks and Flues.

1.3 SYSTEM DESCRIPTION

A. The work includes, but is not limited to providing the following:

1. Liquid Flat Plate Collectors
2. Water Softener

1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with ASHRAE 93-77 (ANSI B198.1) Methods of Testing TO DETERMINE THE THERMAL PERFORMANCE OF SOLAR COLLECTORS.

1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Solar Collectors
2. Water Softeners

B. Test Reports: Submit certified test data for the Collector assembly by an independent lab showing compliance with ASHRAE 93-77 and in accordance with General Conditions of the Contract.

1.6 WARRANTIES

A. Provide original warranties for specific equipment of term specified and in accordance with Section 230500.

B. Solar Collector Warranty: Provide written warranty signed by manufacturer, agreeing to replace/repair defective units where materials or workmanship failures have resulted in leakage of liquid, obstruction of liquid flow, excessive internal soiling, significant loss of efficiency, abnormal aging or deterioration of materials or finishes, or other failures of units or forms of deterioration causing units to not perform as initially required; warranty includes disconnection, removal, reinstallation and reconnection of units.

C. Solar collector product warranty period shall be for a period of 5 years from date of substantial completion as defined in the General Conditions of the Contract

PART 2 - PRODUCTS

2.1 PRODUCT ACCEPTANCE

A. Acceptable Manufacturers are listed for each product, and manufacturers shall submit products that are in fact equivalent in all respects of material, design, function, size, and appearance to the manufacturer specified. Deviations of any type will not be acceptable.

B. Where acceptable manufacturers are not listed, only the manufacturer specified will be accepted.

C. All equipment of like use and nomenclature shall be supplied by one manufacturer only.

2.2 HOT WATER STORAGE TANK

A. Acceptable Manufacturers:

1. American Steel and Iron Works Denver, Co.
2. Western Filter Co., Denver Co.
3. Lochinvar
4. Weben-Jarco
5. Wessels
6. A.O. Smith
7. Adamson
8. Bradford White

9. Hansen Tank
10. Hamilton
11. Rheem
12. PVI
13. Heat Transfer Products
14. Ace/Ajax
15. Laars

B. Provide an ASME certified and labeled and National Board Certified tank, NSF approved epoxy phenolic or polyamide lined, domestic hot water storage tank for 150 psig working pressure. Tank manufacturer to provide tappings of sizes, type and locations required by the contract documents. Provide stratification baffle guarantee 80% draw down without drop in outlet temperature.

C. Provide ASME temperature and Pressure relief valves, tank drain valve, and dielectric unions for all piping connections at tank.

D. Factory paint tank with rust inhibitor primer and finish with two coats of heat resistant black epoxy enamel.

2.3 DOMESTIC HOT WATER CIRCULATING PUMPS

A. Acceptable Manufacturers:

1. Taco
2. Bell and Gossett
3. Grundfos
4. Armstrong
5. Patterson

B. Provide in-line type circulating pumps, all bronze construction, <cast iron> <bronze> face bracket, cast bronze one piece enclosed type impeller hydraulically and dynamically balanced, alloy steel shaft with cupro-nickel shaft sleeve, carbon/ceramic mechanical shaft seal, non metalic noiseless coupler, resilient mounted dry proof motor with sleeve bearings and over load protection, pump bearing and seal assembly shall be replaceable cartridge design, one cartridge and seal to fit all pumps supplied, provide two extra cartridges and seals, oil level dip sticks (one for each pump), and oil drain plug, 125 psig @ 240 deg.F rating.

C. Provide one aquastat pump operating switch for remote mounting as shown on drawings. (One switch per pump).

D. Schedule: See Drawings.

2.4 LIQUID FLAT PLAT COLLECTORS

A. Acceptable Manufacturers: Heat Transfer, Viessmann, Solar Twin, Novan, Silicon Solar inc., Integrated Solar, Apricus.

B. General: Provide manufacturer's standard or custom fabricated liquid solar collector units of the sizes and shapes indicated, complying with the following requirements for materials, finishes, performances, and fabrication details, complete with provisions for installation/anchorage in the positions indicated.

C. The flat plate collector modules from the top to the bottom in cross-section shall consist of the following layers:

1. A tempered single glass cover plate, double strength and 1/8 inch minimum thickness, low iron content. Edges to be swiped.
2. An inner air space.
3. An absorber plate, coated with selective surface film, containing passage ways for circulating water.
4. A backside layer of insulation.

D. These layers shall be supported with a frame and covered with a backside cover plate. The housing for the collector modules shall be weatherproof to avoid water condensation when exposed to outdoor weather conditions. The collector modules shall be identical in size and appearance.

E. Absorber plate shall be metal and shall be soldered or mechanically bonded to the collector fluid passages. The contact areas of the absorber plate with the fluid passage shall be 50% of the exterior area of the fluid passage tube. Effective absorber area shall not be less than 85% of total frontal area.

F. Selective surface shall be black chrome with a minimum absorbitivity of 0.90 and a maximum emissivity of 0.15.

G. Fluid passage tube shall be a maximum of 6 inches on center. Tubes and manifold shall be connected in a reverse return flow pattern within each panel. Manifold and tubes shall be pressure tested to 150 PSI working pressure, manifold and tubes shall be copper. Pressure drops thru panel with water is not to exceed 0.5 psig at 0.03 gpm flow per square foot of absorber.

H. Insulation: The back of the absorber panel shall be insulated with a material to meet the following:

1. Minimum "U" factor 0.10 BTU/sq. ft./deg. F. for total thickness.
2. Insulation shall withstand temperatures up to 450 deg. F. without "outgassing" or thermal resistance degradation.

I. The edge and ends of the absorber panel shall be thermally insulated or isolated from the casing.

J. Casing: The exterior casing of the panel shall be sheet metal or extruded aluminum bolted, screwed or welded together. Tape shall not be used to hold frame together. The casing shall be rigid enough to support total unit including glass in handling and shipping without undue deflection. Casing shall have mounting brackets at easily accessible points for ease of installation. Casing and glazing frame shall allow for removal and replacement of cover glass without removing the collector panel. Casing must be totally weatherproof without additional housing or flashing.

K. Materials used in casing, gasketing, glazing, mounting and finishing shall not "outgas" at temperatures up to 450 deg. F. All materials and assemblies must be capable of operating over an ambient temperature range from -40 deg. F. to 130 deg. F.

L. Collectors shall not exceed 7.5 lbs/sq. ft. of total frontal area.

M. Collector assembly shall be tested by an independent lab in accordance with the latest procedures as outlined in ASHRAE 93-77. This test data is to be submitted with the shop drawings for the collector.

N. Mounting Provision: The sided and/or ends of the collector casing shall be designed to allow for easy mounting of collectors to support frame. Manufacturer to furnish all supports, bracing and cross-bracing to withstand 90 mph winds from any direction.

O. Piping connections to the collector shall be as shown on the drawing. Alternate piping connections may be submitted with a complete array piping layout and details. Alternate piping connections and layouts shall be submitted to the Engineer for acceptance. Provide all required fittings, O-rings, etc. for complete operational system.

P. If collectors of a different size are submitted, the contractor and/or manufacturer shall submit F-Chart data indicating equal or greater energy output than the collector specified and shown. This performance verification shall use the ASHRAE 93-77 efficiency curve and the net aperture area of the total array of the collector specified.

Q. The F-Chart run shall be based on the following:

1. Collector Inlet Temperature: 40°F
2. Flow Rate: 0.8 gpm/ft^2
3. Tilt: 42°F
4. Azimuth: 180°F
5. Location: Roof

R. The F-Chart run shall be for a full year by months. The contractor and/or manufacturer shall provide additional structure, piping and other items necessary for a complete and working system caused by a change from the base specified collector.

2.5 WATER SOFTENER

A. Acceptable Manufacturers: Culligan, Bruner, Columbia, Phoenix, Marlo Inc., CIS Water Treatment Systems.

1. Where manufacturers are listed, these manufacturers must submit products that are in fact equivalent in all respects of materials, design, and function.
2. Where acceptable manufacturers are not listed only the base manufacturer will be accepted.
3. All items of like nomenclature shall be supplied by one manufacturer only.

B. Schedule: See Drawings.

C. Salt: Provide salt installed in brine tank and 250 lbs of salt in not more than 50 lb bags stacked on wood pallets adjacent to brine tank, salt to be Utah Solar Kiln dried coarse or extra coarse grade only, and made for softener use with uniform dissolving free from dirt and foreign particles.

D. Warranty and Service: Provide full 2 year non-prorated warranty starting from date of beneficial occupancy or acceptance by the owner, whichever is first. Manufacturer must have local (within 50 mile radius) full service and parts organization, or not more than 8 hour part delivery and local service available.

PART 3 - EXECUTION

3.1 HOT WATER STORAGE OR ACCUMULATOR TANK

A. Provide structural 2" dia schedule 40 black steel welded pipe stand with 2" pipe cross bracing, 6" x 6" x 1/8" steel leg support plates, 3" wide rolled steel (to tank diameter) saddles with 1/8" plate stiffners, 3" wide x 1/4" thick neoprene pads between saddles and tank.

B. Set stand level and absolutely plumb, slope tank slightly using saddles as shim mechanism, to drain valve at one end of tank to facilitate complete draindown.

C. Provide unions and gate valves for complete isolation of the tank from the system.

D. Provide relief valve with drain extension air gapped to appropriate receptacle.

E. Tank tappings shall be provided as detailed or appropriate, ASME welded tank flanges or nipples.

3.2 DOMESTIC HOT WATER CIRCULATING PUMPS

A. Coordinate wall mounted "on-off" toggle switch for pump and electrical power requirements with Division 26 Contractor in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Set pump level, plumb and square where indicated on contract documents on vertical pipe leg extended to and supported by floor, provide floor plate and capped leg at floor.

C. Provide drain valve on pump support leg at 18" above floor.

D. Anchor vertical pump leg pipe so as to prevent movement and vibration.

3.3 WATER SOFTENER

A. Be responsible to provide or have provided necessary electrical power and control wiring, drain extensions, inter connecting piping, and accessories.

B. Set Brine and Softener tanks level and plumb with rotation required for complete access to all controls and piping.

C. Install resin, salt, and provide palletized extra salt in an area designated by the Owner.

D. Provide factory trained technician for start up of all units.

3.4 INSTALLATION OF LIQUID FLAT PLATE COLLECTORS

A. General: Except as otherwise indicated, install liquid solar collectors including components required, in accordance with manufacturer's instructions.

B. Locate each unit accurately in the position indicated in relation to other work. Position unit with sufficient clearance for installation of piping and for normal service and maintenance, including clearance for removal.

C. Pitch units to the indicated angle, within indicated tolerances. Install shims as required. Anchor securely to supporting structure or substrate as indicated, installing manufacturer's standard recommended support and anchorage system, designed to withstand maximum wind pressures at project site.

D. Installation of piping including hydrostatic testing of completed installation shall be in accordance with Section 232113 - HVAC Piping.

3.5 FIELD QUALITY CONTROL

A. Repair or replace solar collector units which leak or fail to perform as indicated, or are damaged or have broken their seals.

END OF SECTION 224450

SECTION 224460 - SPECIAL PLUMBING EQUIPMENT SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Grease Interceptor.

B. Manholes, Manhole Frames and Covers.

C. Kitchen Equipment.

D. HVAC Equipment.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Materials and Methods.

B. Section 221410 - Plumbing Piping.

C. Section 221411 - Disinfecting Water Supply System.

D. Section 224450 - Plumbing Equipment.

1.4 SUBMITTALS

A. Submit Shop Drawings for the following items under provision of The General Conditions of the Contract:

1. Grease Interceptor.
2. Manholes.

B. Submit Product Data for the following items under provision of The General Conditions of the Contract:

1. Manhole Frames and Covers.
2. Automatic Water Softner.

C. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Grease Interceptor.
2. Automatic Water Softener.

1.5 WARRANTIES

A. Provide original warranties for specific equipment of term specified and in accordance with Section 230500 - Basic Mechanical Requirements.

PART 2 - PRODUCTS

2.1 GREASE INTERCEPTORS (DRAWING CODE GI)

A. Provide grease interceptors for outside installation, constructed of precast concrete with epoxy finish on inside in accordance with jurisdictional authorities requirements, the Contract Documents and acceptable to the International Plumbing Code IPC.

B. Interceptors shall be gravity type 3 pass design and rated for continuous flow with 4 minute minimum retention capacity at rated flow rate.

C. Provide manhole extensions to finish grade, manhole frames and bolted-gasketed covers flow controls, vents, inlet/outlet piping, and all accessories required. Bolts for interceptor lid access shall be stainless steel type 316 only; cast iron, steel, or brass will not be acceptable.

D. Schedule: See Drawings.

2.2 MANHOLES, MANHOLE FRAMES AND COVERS

A. Provide manholes of precast. Precast shall consist of 48" dia. Class II type V reinforced concrete in accordance with ASTM C-478. Top section, shall be built up to grade with brick top or concrete grade rings and cover as detailed on Drawings.

B. Provide frames and covers of Grey Iron ASTM Class 45, with lid indexed "Sanitary Sewer" or "Storm Sewer" as applicable:

Make:	Neenah Foundry Company
Model:	R-1370
Lid:	Type C
Index:	As Specified above
Features:	Non-rocking with minimum size pickhole

2.3 KITCHEN EQUIPMENT

A. In general most items of kitchen furnishings will be provided by Division 11, or the Owner. Contractor shall verify items of trim and fixtures not furnished by these suppliers and provide all items necessary to complete the installation.

B. When required, the following shall apply:

1. Traps: Chrome plated cast brass.
2. Tailpieces: Chrome plated 17 gauge copper.
3. Arms: Chrome plated 17 gauge copper.
4. Escutcheons: Chrome plated, cast brass, set screw type.
5. Stops: Chrome plated brass with wheel handle operators.
6. Supplies: Chrome plated type M copper tube.
7. Indirect Wastes: Type "DWV" or "M" copper tube.
8. Water Piping: Type L copper.
9. Waste & Vent Piping: Type DWV copper tube.
10. Gas: Schedule 40 A-120 black steel T&C with malleable fittings up to 1-1/2". 2" and larger schedule 40 A-53 with butt weld steel fittings and couplers.
11. Gas Connectors: When specifically required provide Thermo Tech Co braided flexible connectors with armor shield, approved for gas, and of lengths required for fixed or movable equipment.
12. Couplings: Provide at each end of flexible connector "Hanson Gas Mate" 2-way shut-off couplers and plugs.
13. Solenoid Valves: Provide "ASCO" gas or water rated 2-way solenoid with actuation and reset as required. Refer also to Section 231123.
14. Joints: Where joints of piping systems are welded, soldered or brazed and are exposed to view or cleaning - buff joints to smooth cleanable surface in accordance with N.S.F.
15. Provide backflow prevention per local code on all equipment connections between domestic water system, i.e. ice machines, coffee brewers, soda stations, etc.

2.4 HVAC EQUIPMENT

A. See Part 3 - EXECUTION portion of this Specification.

PART 3 - EXECUTION

3.1 GREASE INTERCEPTOR

A. Install where shown on Drawings in accordance with jurisdictional authorities.

3.2 MANHOLES FRAMES & COVERS

A. Install where shown on Drawings in accordance with jurisdictional authorities.

3.3 KITCHEN EQUIPMENT

A. Kitchen equipment and appliances will in general be furnished under Division 11.

B. Responsibilities shall conform to the following schedule:

NEW OR REUSED EQUIPMENT AND APPLIANCES	OC	PC
Provided by:	X	
Uncrated by:	X	
Set in place by:	X	
Rough-in by:		X
Connected by:		X

OC = Division 11 Contractor
PC = Division 22 Contractor

D. The Division 22 Contractor shall furnish and install all equipment and trim as scheduled above and as hereinafter specified.

1. Provide traps with cleanouts, tubing waste to wall including escutcheons, of sizes as required.
2. Chrome-plated water supplies and branches complete with individual and branch shut-off chrome-plated valves (globe pattern), and chrome-plated brass escutcheons as required.
3. Gas supplies, complete with lubricated plug valves at point of entry through walls or floors, flexible hose with armor shield from branch to appliance, and connections to the appliance made with "Hanson Gas-Mate" quick coupler type valves only.
4. All extensions of chrome-plated brass indirect waste piping from unit connection to air gapped connections to floor drains or waste receptacles at termination point.
5. All necessary solenoid or motorized valves not furnished as parts of kitchen equipment.
6. All necessary specialties not specifically mentioned, but necessary for proper and complete operation of the unit, or for good appearance and a clean finished contract.

E. All trim and specialties, including valves and piping, shall be chrome plated brass or chrome plated copper where components are not concealed from view. Trim and specialties within cabinets will not be considered concealed.

3.4 HVAC EQUIPMENT

A. Provide rough-in and final connection to HVAC equipment as indicated on drawings and as required to provide a complete and functional system. Hookups shall include, but not be limited to, the following: Glycol fill stations, evaporative media, snowmelt systems, chemical feed systems, cooling tower, etc.

END OF SECTION 224460

SECTION 230500 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Basic requirements common to the work in general of Division 23 and other Divisions and Sections of the Specification where referenced.

B. Provide, unless specified otherwise, all labor, materials and equipment necessary for completely finished and operational mechanical systems described and specified under other Sections of this Division 23.

C. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the work even though not specified or indicated.

D. Inspection: Inspect work preceding or interfacing with work of Division 23 and report any known or observed defects that affect the Work to the Construction Manager/General Contractor. Do not proceed with the work until defects are corrected.

E. Existing Utilities: Are indicated as accurately as possible on the Drawings. Close openings and repair damage in acceptable manner to utilities encountered. This Contractor shall be responsible for field surveying all aspects of existing conditions prior to bid date. Change orders will not be issued for a failure to review existing conditions which affect Division 230000 work.

F. Commissioning is required on this project. Reference sections 230900, 019113.

1.2 GENERAL PROVISIONS

A. Division 23 will be responsible to carry out the commissioning requirements specified in Section 230900 and other sections referenced in 019113.

1.3 RELATED WORK

A. Requirements: Provide Basic Requirements in accordance with the Contract Documents.

B. Division 1 Commissioning, coordinate as required.

1.4 UTILITIES, EXTENSIONS, CONNECTIONS AND FEES FOR WATER AND SEWER

A. Provide all building services extensions and connections to off-site and on-site utilities.

B. Sewer connection charges, typically based on fixture units, that in principle allow the right to obtain the sewer services from the utility will be arranged and paid for by the Division 23 Contractor.

C. Water system development fees, typically based on meter size, that in principle allow the right to obtain the water services from the utility will be arranged and paid for by the Site Utilities Contractor.

D. Sewer tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities Contractor.

E. Water tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities Contractor.

F. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the Division 23 Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the Division 23 Contractor.

G. Be responsible for all pads, vaults, manholes, manhole covers, meter enclosures, valves, services boxes, and the like, all in conformance with requirements of the serving utility company.

H. In the event that the water service to the building is a combination domestic and fire protection service, the responsibility of said "combination service" to the point of domestic connection shall be that of a licensed Fire Protection Contractor, including tap, valves, excavation, backfill, compaction and meters, if any. After point of domestic connection, responsibility for separate fire and domestic services is with appropriate trades including all labor and materials as herein before mentioned.

1. Contractor shall coordinate with other trades all interface piping and types of connections to be provided for interface.
2. Provide fire hydrant, auxiliary gate valve, tapping sleeve and valve or tee, service boxes, and anchor or swivel couplings, thrust blocks, deadmen, rods, and the like, all in conformance with the requirements of serving utility company.

1.5 REFERENCES

A. General:

1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
2. The date of the standard is that in effect at the date of the Contract Documents, except when a specific date is specified.
3. When required by individual Specification sections, obtain copy of standard. Maintain copy at job site during work until substantial completion.
4. Coordinate and reference with Division 016500.

B. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

ADC	Air Diffusion Council 1000 E. Woodfield Rd. Schaumburg, IL 60173 www.flexibleduct.org
AGA	American Gas Association 400 No. Capitol St. N.W. Washington, DC 20001 www.aga.org
AMCA	Air Movement and Control Association 30 West University Drive Arlington Heights, IL 60004 www.amca.org
ANSI	American National Standards Institute 1819 L Street N.W. Washington, DC 20036 www.ansi.org
ARI	Air Conditioning and Refrigeration Institute 4301 No. Fairfax Drive. Arlington, VA 22203 www.ari.org
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329 www.ashrae.org
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016 www.asme.org
ASPE	American Society of Plumbing Engineers 8614 W. Catalpa Ave. Chicago, IL 60656 www.aspe.org
ASSE	American Society of Sanitary Engineering 901 Canterbury Westlake, OH 44145 www.asse-plumbing.org
ASTM	American Society for Testing and Materials 100 Barr Harbor Dr. West Conshohoeken, PA 19428 www.astm.org

AWS	American Welding Society 550 N.W. LeJeune Rd. Miami, FL 33126 www.aws.org
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235 www.awwa.org
CDA	Copper Development Association 260 Madison Avenue New York, NY 10016 www.copper.org
CISPI	Cast Iron Soil Pipe Institute 5959 Shallow Ford Rd., Suite 419 Chattanooga, TN 37421 www.cispi.org
CS	Commercial Standard of NBS (U.S. Dept. of Commerce, National Institute of Standards and Technology) Government Printing Office Washington, D.C. 20402
CTI	Cooling Technology Institute 530 Wells Fargo Drive Houston, TX 77090 www.cti.org
ICC	International Code Council 5203 Leesburg Pike, Suite 600 Falls Church, VA 22041 www.intlcode.org
IAPMO	International Association of Plumbing and Mechanical Officials 20001 E. Walnut Drive South Walnut, CA 91789 www.iapmo.org
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 www.nebb.org
NEC	National Electric Code (of NFPA)
NEMA	National Electric Manufacturer's Association 1300 N. 17th Street Rosslyn, VA 22209 www.nema.org

NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincey, MA 02269 www.nfpa.org
NSF	NSF International 789 No. Dixboro Rd. Ann Arbor, MI 48113 www.nsf.gov
OSHA	Occupational Safety Health Administration (U.S. Dept. of Labor) Government Printing Office Washington, D.C. 20402 www.osha.gov
PDI	Plumbing and Drainage Institute 45 Brystal Drive South Easton, MA 02375 www.pdionline.org
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association 4201 Lafayette Center Drive Chantilly, VA 20151 www.smacna.org
UL	Underwriters Laboratories, Inc. 333 Pfingston Rd. Northbrook, IL 60062 www.ul.com

1.6 DEFINITIONS

A. Specification Language Explanation: These Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences. Omissions of words of phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the drawings", "a", "the", are intentional. Supply when "NOTE" occurs on Drawings. Supply words "shall be" or "shall" by inference when colon is used with sentences or phrases. Supply words "on the Drawings" by inference when "as indicated" is used with sentences or phrases. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.

B. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

C. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

D. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

E. Indicated: The term "Indicated" is a cross-reference to graphics, notes or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.

F. General Contractor: The term "General Contractor" used in Division 23 and elsewhere in the Contract Documents means the party with whom the Owner has executed the Owner-Contractor Agreement.

G. Approved Equal: Except as otherwise defined in greater detail, term "approved equal" means that any materials, equipment, work procedures and techniques shall be either addressed on the drawing, specifications or addendum by manufacturer or by detailed material description. When brand names are referenced it implies that only the manufacturers listed are approved. All approved material, equipment, work procedures, and techniques will be noted in the specifications, drawings, or by addendum prior to bid date. Items not approved in this manner will not be considered.

1.7 QUALITY ASSURANCE

A. Quality Control:

1. Materials and apparatus required for the work to be new and of first-class quality; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article shall be furnished.
2. Furnish the services of an experienced superintendent, who will be constantly in charge of the installation of the work, together with all skilled workmen, fitters, metal workers, certified welders, plumbers, millwrights, sprinkler fitters, drain layers, helpers, and labor required to unload, transfer, erect, connect, adjust, start, operate and test for each system.
3. Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the manufacturer. This includes the performance of tests as recommended by the manufacturer.

B. Proof of Performance:

1. Division 23 Contractor shall provide proof of performance certification of all Mechanical Equipment and Systems to demonstrate that all Mechanical Equipment and Systems are operating to the intent of the design. This proof of performance shall include, but shall not be limited to, actual demonstration of all temperature/pressure control loops, operation of all heating/cooling equipment and other required tests upon request by the Engineer or Owner. A signed certificate from the piping, sheet metal, control, and balancing subcontractors stating that they have personally checked the operation of all equipment and control loops and that everything under their subcontract is operating as specified. These certificates shall be furnished to the 230593 Contractor for inclusion in the Operation and Maintenance Manual.

C. All system components, controllers, host computers, portable terminals, and similar equipment, all hardware and software (including third party products) furnished by this contractor shall conform to the following:

1. General Integrity: No value for current date (minimum range from 1980 to 2036) will cause any interruption in operation.
2. Date Integrity: Date-based functions shall behave consistently for dates prior to, during, and after Year 2000 (minimum range from 1980 to 2036).
3. Explicit/Implicit Century: The century in any date shall be specified either explicitly or by unambiguous algorithms or inferencing functions.

1.8 REGULATORY REQUIREMENTS

A. Execute work per Underwriters, Public Utility, Local and State Codes, Ordinances and applicable regulations. Obtain and pay for required permits, inspections, and certificates. Notify Architect of items not meeting said requirements.

B. Comply with editions of all applicable codes, ordinances and regulations in effect at the time of bid opening including but not necessarily limited to the following:

International Mechanical Code
International Plumbing Code
International Fuel Gas Code
State Department of Health Requirements
State Energy Code
National Fire Protection Association Standards
International Fire Code
International Building Code
National Electrical Code NFPA-70
State Boiler Code
Jurisdictional County Health Department
Jurisdictional City Wastewater Management Division or District
Jurisdictional City Water Department
Jurisdictional Water Conservation Standards
Code and Manual for the Design and Installation of Mechanical Warm Air Heating Systems – Nation Warm Air Heat and Air Conditioning Association (NWAH and ACA) Manual #9, 4th Edition.
ASME Boiler Construction Code for Low Pressure Heating Boilers.
ASME Boiler and Pressure Vessel Code.
Unfired Pressure Vessels – ASME Boiler and Pressure Vessels Codes, including Sec. VIII
Code of Minimum Requirements for Comfort Air Conditioning (ASHRAE).
Building Materials and Structures (BMS).
American Standard Plumbing Code ASA A40.
Utah Plumbing Code.
Uniform Building Code of the Pacific Coast Building Officials Conference.
Utah Code for Energy Conservation in New Building Construction.
Ogden City Codes and Regulations as applicable.
State of Utah Boiler and Pressure Vessel Compliance Manual.
Standards of Tubular Exchanger Manufacturers Association – TEMA Standards for Class “C” Heat Exchangers.
Standards for the Installation for Air Conditioning and Ventilating Systems other than Residence Type – National Board of Underwriters (NBFU) and National Fire Protection Association (NFPA) Pamphlet No. 90A.
NBFU Sprinkler Equipment Standards.

American Society of Heating, Refrigerating and Air Conditioning Engineers Standards.
American Welding Society Sandards.
DFCM Design Manual.
Weber State University Design and Construction Standards

C. If discrepancies occur between the Contract Documents and any applicable codes, ordinances, acts, or standards, the most stringent requirements shall apply.

D. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the IBC, and listed by Underwriters Laboratories, Inc.

1.9 SUBMITTALS

A. Submit items to Commissioning Agent for review. Contractors are required to submit Mechanical Cost Breakdown to Engineer when submitting shop drawings. Shop drawings will not be accepted without a complete Mechanical Cost Breakdown. See last page of this Section for requested breakdown. If your standard compilation of bids is different than our requested breakdown, please send it in your format. We need the data to keep our cost estimating files up to date. Just fill-in blanks with a pencil, typing is not required.

B. Submit Samples, Shop Drawings and Product Data as required by various Sections of Division 23 in accordance with The General Conditions of the Contract. The Contractor agrees that these Submittals processed by the Engineer are not Change Orders; that the purpose of these Submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. Contractor further agrees that if deviations, discrepancies, or conflicts between these Submittals and the Contract Documents in the form of design drawings and specifications are discovered either prior to or after these Submittals are processed by the Engineer, the Design Drawings and Specifications shall control and shall be followed.

C. The submittals shall be submitted in a single package with all mechanical equipment for the project enclosed. The submittals shall be both electronic (Adobe Acrobat .pdf format) and hard copies enclosed in a stiff back, 3-ring binder. All mechanical equipment shall be separated with tabbed index cards with an indexed legend provided in the front of the binder.

D. Test Reports: Submit certified test reports as required by various Sections of Division 23 showing compliance in accordance with General Conditions of the Contract. Signed copies shall be included in the Operation and Maintenance Manual.

E. Operating Instructions and Maintenance Data: Prepare and submit printed operating instructions and maintenance data in accordance with Operating and Maintenance Data paragraph in this Section.

F. Submittals will be reviewed and marked as follows:

1. Approved: Submittals are accepted as submitted.
2. Make Corrections Noted: Correct the submittals per notes by engineer and submit new copies of submittal to contractor for project records. Do not resubmit to Engineer.

3. Revise as Noted: Correct the submittals per notes by Engineer and resubmit to Engineer for approval.
4. Rejected: Equipment as submitted does not meet requirements of contract documents. Revise and/or clarify per comments and resubmit to Engineer.
5. Submittal Not Requested: Submittal not required per specification. Submittal returned with no review.

G. Note that the submittal review process does not relieve Contractor from being ultimately responsible for ensuring that submitted items satisfy all requirements of the Contract Documents.

H. Site Condition and Coordination:

1. Before any ductwork is fabricated or equipment installed and before running and/or fabricating any lines of piping or ductwork, the Contractor shall provide Architect and Engineer ¼" scale drawings of all mechanical rooms and main access walkways coordinated with all trades with submitted equipment and verify all other areas to assure himself that they can be run and installed as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work and maintain access walkways are clear for maintenance.

1.10 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Substitutions and Prior Approvals: Substitutions and prior approvals will be acceptable only when the proposed substitute has been submitted to the Engineer and approved through an addendum or change order. Request for prior approval shall be submitted a minimum of 10 calendar days prior to bid.

B. Some materials and equipment are specified by manufacturer and catalog numbers. The manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.

C. NOTE: When alternate or substitute materials and equipment are used Division 23 Contractor shall be responsible for engineering/redesign costs, space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use. Notification of General Contractor and other affected subcontractors shall be the responsibility of the Division 23 Contractor.

1.11 PROJECT RECORD DOCUMENTS

A. General: Comply with Division 1.

B. Job Site Documents: Maintain at the job site, one record copy of the following:

1. Drawings, including mechanical, plumbing and fire sprinkler.
2. Specifications
3. Addenda
4. Reviewed Shop Drawings
5. Field Test Records

Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.

C. Record Information: Label each document "Record Document". Mark information with red ink. Keep each record current. Do not permanently conceal any work until required information is recorded.

D. Record following information on Drawings:

1. Horizontal and vertical location of underground utilities to be dimensioned from column lines.
2. Dimensioned location of internal utilities and appurtenances concealed in construction.
3. Field changes of dimension and detail.
4. Changes by change order or field order.
5. Details not on original contract drawings.
6. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed shall be indicated on equipment schedules.

E. Record the following information on Specifications:

1. Changes by change order or field order.
2. Other matters not originally specified.

F. Contractor redlines due to Architect/Engineer by “Certificate of Occupancy” issued to Owner.

G. Shop Drawings: Maintain shop drawings as record documents recording changes made after review as specified for drawings above.

H. Submittal: At completion of project, deliver record documents to Owner's representative and transmit a copy of signed receipt from Owner to the Engineer.

1.12 OPERATING AND MAINTENANCE DATA

A. The "Operating and Maintenance Manual" (O & M) is a bound compilation of descriptive drawings and data which identify equipment installed at the project site and detail the procedures and parts required to maintain and repair the equipment. Copies of final reviewed submittals shall be included for all equipment items.

B. Five sets of bound manuals will be required for this project. These are to be submitted for approval to the Project Manager. Five electronic versions of the manuals are also required, as described in Paragraph I below.

C. Division 23 Contractor shall submit all information in electronic (Adobe Acrobat) format (CD) in addition to five (5) typed and bound copies of the maintenance manual, 8-1/2” x 11” in size, to the Mechanical Consulting Engineer for approval before substantial completion. These approved copies will be returned to the Contractor and shall then be transmitted to the Owner.

D. Organization of the manuals shall follow the recommendations in ASHRAE Guideline 4-1993.

D. Enclose the material in rigid 3-ring or metal post binders and submit to the Project Manager at the completion of the project. Binders shall be Buckram or metal post binders or prior approved equal with block lettering. Simple binders with slide-in cover sheets are not acceptable. Sheet size shall be 8-1/2" x 11" with expandable metal capacity as required for the project. The number of binders forming one O & M Manual shall be based on a maximum limit of 4 inches. The following information shall appear on the front cover and backbone:

1. "Operation and Maintenance Manual"
2. Project Name (and volume number if more than one volume)
3. Project number
4. Building name, number, and street address
5. * Architect's name
6. * Engineer's name
7. * General Contractor's name
8. * Mechanical Contractor's name

* Items "5" through "8" need not be printed on the backbone.

E. Pages are to be standard 8-1/2" x 11" sheets, or 11" x 17" folded to fit the 8-1/2" x 11" sizes.

F. The manual shall be both electronic (Adobe Acrobat .pdf format) and hard copy enclosed in a stiff-back, three-ring binder and shall include the following:

1. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/shutdown and long-term shutdown. Note that these instructions are for entire systems. Simply providing manufacturer’s shutdown procedures for individual components is unacceptable.
3. Maintenance instructions, including valves, valve tag and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and complete systems and necessary cleaning/replacing/adjusting schedules.
4. All test reports and proof of performance certificates.
5. Manufacturer's data and instruction sheets for each piece of equipment, marked to indicate the plan symbol, model, number, and options installed for each item of equipment furnished and installed on the project. These data sheet shall be accompanied by reviewed submittals that had no exceptions taken to them. Provide original printed material in each book, faxes are NOT acceptable. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.

    a. Installation instructions.
    b. Drawings and specifications (final shop drawings).
    c. Parts lists.
    d. Complete parts lists, and a source of supply for each piece of equipment, marked with model, size, and plan symbol.
    e. A copy of the reviewed submittals for each piece of equipment, with any/all corrections identified during the submittal process made to the final submittal documents.

f. Performance curves and capacity data, marked with model number, size, and plan code.
g. Complete “as-builts” wiring and temperature control diagrams. (Shop drawings are not acceptable).
h. Lubrication and other preventative maintenance data.
i. Equipment warranties.
j. The final balance report.

6. Design Intent Document furnished by Engineer.
7. Include a Table of Contents and tabbed index dividers.

G. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified on drawings. Insert a copy of the Equipment List or Equipment Schedules in manual.

1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches. Label with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
2. Tag all manual operating valves per requirements in Section 230529.
3. Provide a typed tag list or schedule laminated or mounted under plexiglass in the equipment room stating valve ID number, location, service and function of each tagged item, and normal valve position. Insert a copy of tag list in each "Maintenance Manual". Also provide one copy of the list in a plastic closure as manufactured by Seton Name Plant Company, New Haven, Conn; or approved equal. The plastic closure shall include two holes punched at the top, with a brass or nickel grommet in each hole, and an 8” long length of nickel plated bead chain run through the holes, allowing the list to be hung from a wall peg.
4. Provide a reduced scale drawing of each floor indicating the location of each manual and automatic valve in every HVAC and plumbing piping system and include valve position number and normal valve position (normally open/normally closed) as per Specification Section 230529. Mount all drawings under plexiglass or laminate and mount on equipment room wall.

H. Division 230593 Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all mechanical systems, using the maintenance manual as a guide. This individual will be knowledgeable of all systems and manufacturers maintenance and operation recommendations. These meetings must be scheduled through the Architect, Construction Manager/General Contractor and far enough in advance so that all necessary personnel can be adequately notified. These meetings to be video-taped.

1. Submit training certificate and copy of video to Owner’s Representatives at end of training and have certificate signed to indicate adequate training has been received.

I. Operating and Maintenance Data documents must be provided in digital format as follows:

1. Provide O&Ms in an intuitive format on a CD-ROM or DVD. Electronic manual preparation shall be under the direction of an individual or organization that has demonstrated expertise in the preparation of a comprehensive and complete electronic operation and maintenance manual. Qualifications shall be submitted for approval. One source of procurement used on past projects is Emanuals by Scanitall in Sandy, UT (tel. 801-619-2082). This is the responsibility of the Division 21/22/23 contractor.

2. A single CD or DVD to be authored with the latest edition of Adobe Acrobat, and be in a “non-protected” network accessible format.
3. All information on the CD-ROM or DVD shall be printable on 8.5”x11” or 11”x17”plain paper.
4. Capture images using OCR technology such that the user can key word search for information.
5. Provide a hypertext alphabetical index of all equipment and building products. All hypertext shall be blue in color.
6. Provide 3 copies of the O&M CD-ROM or DVD.

1.13 OPERATING AND MAINTENANCE MANUALS

A. The "Operating and Maintenance Manual" (O & M) is a bound compilation of both electronic (Adobe Acrobat .pdf format) and hard copy descriptive drawings and data which identify equipment installed at the project site and detail the procedures and parts required to maintain and repair the equipment. Also, provide a CD-ROM that includes all O & M information included in hard copy. Copies of approved submittals shall be included for all equipment items.

B. Four sets will be required for each project. These are to be submitted for approval to the Project Manager.

C. All data and instruction sheets shall be marked to indicate the plan symbol, model, number, and options installed for each item of equipment furnished and installed. These data sheets shall either be reviewed and approved submittals or shall be accompanied by such.

D. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.

E. Pages are to be standard 8-1/2" x 11" sheets, or 11" x 17" folded to fit the 8-1/2" x 11" sizes.

F. Additionally, the following information is to be included:

1. A complete parts list(s) and source of supply for each piece of equipment, marked with model, size, and plan symbol.
2. A copy of the approved submittals for each piece of equipment.
3. The balance report.
4. Performance curves and capacity data, marked with model & size and plan symbol.
5. Wiring diagrams and control sequences marked with model, size and plan symbol in hard copy and AutoCAD format.
6. Control sequences and point schedules from Control Contractor.

G. Enclose the material in rigid 3-ring binders and submit to the Project Manager at the completion of the project. Binders shall be Buckram binders or prior approved equal with block lettering. Sheet size shall be 8-1/2" x 11" with expandable metal capacity as required for the project. The number of binders forming one O & M Manual shall be based on a maximum limit of 4 inches.

H. The following information shall appear on the front cover and backbone:

1. "Operation and Maintenance Manual"

2. Project Name (and volume number if more than one volume)
3. Project number
4. University name, Building name, number, and street address
5. * Architect's name
6. * Engineer's name
7. * General Contractor's name
8. * Mechanical Contractor's name

* Items "5" through "8" need not be printed on the backbone.

I. Include a Table of Contents and tabbed index dividers.

1.14 DELIVERY, STORAGE AND HANDLING

A. General: Deliver and store materials and equipment in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.

B. Protection: Store materials and equipment off the ground and under cover, protected from damage. Maintain caution labels on hazardous materials.

C. Large Items: Make arrangements with other contractors on the job for introduction into the building of equipment too large to pass through finished openings.

D. Handling of Materials: Materials shall be handled, sorted and distributed using appropriate handling methods to protect all materials from damage. Dented, rusted, corroded or otherwise damaged materials shall be removed from the project site. Determination of materials deemed unusable or inappropriate for installation shall be made by the Architect/Engineer.

1.15 PROJECT CONDITIONS

A. Accessibility and Coordination:

1. Division 23 Contractor shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for proper installation of his work. He shall hold coordination meetings with all trades and Contractors of other Divisions of the Work whose work is in the same space and shall provide coordination drawings showing mechanical, sheet metal, electrical, data, plumbing, fire sprinkler, and indicate pinch points and verify all items will fit before any fabrication is begun or equipment is ordered. Keep one (1) set of these drawings on site at all times. Provide a set of these drawings to the Construction Manager, General Contractor, Commissioning Agent, Architect, and Engineers for review. Such spaces and clearances shall, however, be kept to the minimum size required.
2. Division 23 Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include (but not be limited to) valves, shock absorbers, traps, cleanouts, motors, controllers, switchgear, filters, VAV boxes, control valves, balancing valves, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the Architect/Construction Manager/General Contractor prior to making the change.

3. Division 23 Contractor shall provide the Construction Manager/General Contractor with the exact locations of access doors for each concealed valve, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.
4. Division 23 Contractor to coordinate all utility shutdowns with Campus Project Manager at least 7 days prior to the proposed shutdown.

B. Fabrication:

1. Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the Contractor shall provide Architect and Engineer ¼" scale drawings of all mechanical rooms with submitted equipment and verify all other areas to assure himself that they can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

C. Freeze Protection:

1. Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection.

D. Scaffolding, Rigging and Hoisting:

1. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required.

E. If Contractor during the course of work observes or suspects the existence of asbestos in the structure or building, Contractor shall promptly notify Owner and Architect/Engineer. Owner shall consult with Architect/Engineer regarding removal or encapsulation of the asbestos material and Contractor shall not perform any work pertinent to the asbestos material prior to receipt of special instructions from Owner through the Architect/Engineer.

1.16 COORDINATION

A. General: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.

B. Coordination with Electrical Work: Section 230529.

C. Utility Interruptions: Coordinate mechanical utility interruptions with the Owner and the Utility Company. Plan work so that duration of the interruption is kept to a minimum.

D. Cutting and Patching: Section 230529.

E. Drawings and Specifications: The Mechanical Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown is diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Take dimensions, measurements, locations, levels, etc., from the Architectural Drawings and equipment to be furnished.

F. Each Division 23 subcontractor shall coordinate with other contractors to make certain that any of his equipment, piping or ductwork which is mounted on isolators or flexibly connected does not become "grounded" by another contractors work (e.g. walls, ceiling, etc.).

G. Discrepancies: Examine Drawings and Specifications for other parts of the work, and if any discrepancies occur between the plans for the work of this Division and the plans for the work of others, report such discrepancies to the Construction Manager/General Contractor and obtain written instructions for any changes necessary.

H. Order of Precedence: The precedence of mechanical construction documents are as follows:

1. Addenda and modifications to the Drawings and Specifications take precedence over the original Drawings and Specifications.
2. Should there be a conflict within the Specifications or within Drawings of the same scale, the more stringent or higher quality requirements shall apply.
3. In the Drawings, the precedence shall be Drawings of larger scale over those of smaller scale, figured dimensions over scaled dimensions and noted materials over graphic indications.
4. Should there be a conflict in dimensions or locations between Mechanical Drawings and Architectural Drawings, the Architectural Drawings shall have precedence.

I. Schedule all shutdowns of utilities 2 weeks prior to shutdown with Weber State University Campus Design Office.

1.17 START-UP PROCEDURES

A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, proper control sequence, and any other condition which may cause damage to equipment or endanger personnel.

B. Insure that all control systems are fully operational in automatic mode. Individually test each control loop to make certain it is operating as intended and is communicating properly with other devices.

C. If systems are not to continue in use following the start-up procedures, steps should be taken to insure against accidental operation or operation by unauthorized personnel. Provide padlocks on disconnect switches where applicable.

D. Factory personnel shall be notified as appropriate to start systems requiring their services.

E. Notify engineer at least 2 weeks prior to the scheduled start-up date of all major mechanical equipment and systems.

1.18 SCHEDULE OF TESTING

A. Provide testing in accordance with the General Conditions of the Contract.

B. A schedule of testing shall be drawn up by the Division 23 Contractor in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.

C. All testing must be performed in the presence of the Architect's/Construction Manager's/General Contractor's representative; his signature for verification of the test must appear on the schedule.

D. All testing must be performed in accord with the procedures set forth in Division 23 and other Sections of the Specifications where referenced. At completion of testing, the completed schedule shall then be submitted in triplicate to the Architect and a copy shall be forwarded to the 230593 Contractor for inclusion in Operation and Maintenance Manual.

E. Make all specified tests on piping, ductwork and related systems as specified in this specification.

F. Make sure operational and performance tests are made on seasonal equipment.

G. Complete all tests required by Code Authorities, such as smoke detection, life safety, fire protection and health codes.

H. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters cleaned or replaced, settings on pressure relief valves properly adjusted, valve and pump packings properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required.

1.19 CLEANING AND FINISHING

A. Provide cleaning in accordance with the General Conditions of the Contract and Division 1.

B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints and other foreign materials from sight-exposed piping, ductwork, equipment, fixtures and other such items installed under Division 23 of the work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.

C. Section 232113 Contractor shall be responsible to certify that all HVAC Piping Systems have been cleaned in accordance with Section 232500 - HVAC Water Treatment whether actually done by the Section 232113 Contractor or by the 232500 Contractor.

1.20 WARRANTIES

A. Warranty: Provide a written warranty to the Owner covering the entire mechanical work to be free from defective materials, equipment and workmanship for a period of one year after Date of Acceptance. During this period provide labor and materials as required to repair or replace defects. Provide certificates for such items of equipment which have warranties in excess of one year. Submit to the Construction Manager/General Contractor for delivery to the Architect. Include a copy of all warranties in the Operation and Maintenance Manual.

B. This warranty will be superseded by the terms of any specific equipment warranties or warranty modifications resulting from use of equipment for construction heat or ventilation.

C. All refrigeration compressors shall have a (4) four year extended warranty from the manufacturer of the equipment in addition to the standard one-year warranty.

1.21 PROJECT CLOSEOUT

A. Project Observation Reports:

At or near the completion of the construction phase of this project, the Engineer will generate one or more Project Observation Reports for the owner. These reports will list the items of construction observed by the Engineer which are not in compliance with the Contract Documents.

The Mechanical Contractor and/or subcontractors shall certify completion of each listed item in writing and forward copies to the Architect, Engineer and General Contractor. The Engineer will not recommend the payment of retainage until this compliance certification has been received.

Each item on the Project Observation Report shall have a signature/date in the margin of the report indicating completion of that item.

1.22 CERTIFICATES AND KEYS

A. Certificates: Upon completion of the work, deliver to the Construction Manager/General Contractor one copy of Certificate of Final Inspection.

B. Keys: Upon completion of work, submit keys for mechanical equipment, panels, etc. to the Construction Manager/General Contractor.

1.23 UNIT PRICES

A. Refer to Section 012200 – Unit Prices where scope and description of unit prices are given.

END OF SECTION 230500

SECTION 230529 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Work furnished but not installed by this Contractor:

1. Access doors in accordance with paragraph 2.3 in this Section 230529.

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

Materials and methods common to the work in general of Division 23 and other Divisions and Sections of the Specifications where referenced.

1.3 QUALITY ASSURANCE

A. Welder Qualifications: Welding shall be performed by an ASME Certified welder with current certificate in accordance with ANSI B31.1 for shop and project site welding of piping work. Welder Qualifications:

1. Each welder shall have passed a qualification test within the past 6 months.
2. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications", ASME Section VIII, and ANSI 313.
3. The test report shall certify that the welder is qualified to weld the material to be used at the job site.
4. The Contractor shall submit three copies of each welder's qualification test report to the Project Manager for approval prior to commencing the work. No welder shall be used on the project until so certified.

1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. For electrical equipment and products, comply with applicable National Electrical Manufacturers Association (NEMA) Standards, and refer to NEMA Standards for definitions of terminology herein.
2. Comply with National Electrical Code (NEC) NFPA-70 for electrical installation requirements.
3. Certified Pipe Welding Bureau (NCPWB) and American National Standards Institute (ANSI) Code Numbers B31.2, & B31.9 as applicable for welding requirements.

4. Comply with American National Standards Institute (ANSI A13) for identification of piping systems.
5. Comply with American National Standards Institute (ANSIB31.1) Code for Pressure Piping.
6. State of Utah, Division of Facilities Construction and Management Design Criteria.
7. Weber State University Design and Construction Standards for Architects, Engineers and Contractors, revised October 2009.
8. Use all applicable inspection, testing, and turnover forms by DFCM Design Criteria dated June 11, 2009, Mechanical Appendix 1, Attached in Part 3 of this section.

1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Legend and color of piping and equipment identification.
2. Freeze Protection Systems for Piping and Equipment (Heat Tracing).
3. Domestic Hot Water Heat Maintenance System.

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data Paragraph in Section 230500.

1. Motors.
2. Starters.

C. Certificates: Before proceeding with the Work, submit to the Architect/Construction Manager/General Contractor, two copies of Certification that the welding work will be done according to ANSI B31.1 by welders who have been tested and whose qualification test sheets are available, attesting to their ability to weld in accordance with the Standard Procedure Specifications as established by the National Certified Pipe Welding Bureau.

PART 2 - PRODUCTS

2.1 MOTORS

A. General: Furnish motors necessary to operate mechanical equipment.

B. Motor Characteristics: Comply with the following requirements:

1. Variable Speed Drive Compatibility: All motors which are powered through a variable frequency drive shall conform to NEMA MG-1, Part 31 for inverter duty and shall be capable of continuous operation at 20% of nominal speed and shall meet the requirements of the Variable Frequency Drive specification in Section 230810 or Division 26 as applicable.
2. Altitude Deration: Motors to be furnished to maintain specified rated service factor at altitude of project.
3. NEMA Temperature Rating: Rated for 40 deg.C environment for continuous duty at full load, Class B motor temperature rise. Motors for use with variable frequency drives shall be Class F insulated.

4. Starting Capability: Provide each motor capable of making starts as frequently as indicated by the automatic control system.
5. Phases and Current Characteristics: Provide squirrel-cage induction polyphase motors for 3/4 horsepower and larger, and provide capacitor-start single-phase motors for 1/2 horsepower and smaller. One-sixth horsepower and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 and with individual equipment requirements specified in other Sections of Division 23. Provide two separate windings on polyphase two speed motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
6. Power Factor: All motors rated greater than 1000 watts shall have a Power Factor of not less than 95% under rated load conditions. The 95% PF may be obtained by design of the motor or by providing a capacitor. Capacitors, if provided to obtain the 95% PF, must be switched with the motor. If the motor draws less than 1000 watts at full load, it is excluded from the 95% power factor requirement.
7. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors. Motors shall be selected such that the brake horsepower requirement is not within the service factor at design load.
8. Efficiency: All motors shall be premium efficiency type in accordance with the current State Energy Code, except where a higher efficiency is noted on drawings.
9. Motor Construction: Provide Design "B" motors for general purpose continuous duty and Design "C" motors where required for high starting torque such as the low speed motor on fans with a two-motor drive arrangement. Small motors that are part of packaged equipment may be manufacturer's standard motors meeting Energy Code requirements for efficiency.

    a. Bearings: Ball or roller bearings with inner and outer shaft seals: regreasable; except permanently sealed where motor is normally inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in the motor, provide bearings designed to resist the thrust loading. Refer to individual sections of Division 23 for fractional horsepower light-duty motorized equipment where sleeve-type bearings are permitted.
    b. Enclosure Type: Except as otherwise indicated, provide open drip-proof motors for indoor use where satisfactorily housed during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual Sections of Division 23 for other enclosure requirements.
    c. Overload Protection: Provide built-in thermal overload protection for each leg of each phase and, where indicated, provide internal sensing device suitable for signaling and stopping the motor at the starter. Thermal overload protectors shall be sized to accommodate the altitude of installation.
    d. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, NEMA efficiency, power factor, special features and similar information.
    e. Motor Connections: Provide conduit connection boxes.
    f. Motors shall not exceed 80dbA rating when running their full speed and power range.

2.2 STARTERS

A. Note that some starters are furnished and installed under Division 26. Review electrical plans before bidding.

B. General: Furnish starters and contactors necessary to operate mechanical equipment motors. **Starter manufacturer shall be the same brand for ALL motors furnished under Division 23.** Approved manufacturers shall be those listed in Division 26 or this specification.

C. Motor Starter Characteristics: Comply with NEMA standards and NEC. Furnish Type I general purpose enclosures with padlock ears, and with frames and supports for mounting on wall, floor or panel as required. Furnish the type and size of starter recommended by the motor manufacturer and equipment manufacturer for the applicable protection and start-up condition; refer to individual equipment sections for basic load requirements. All starters shall be by the same manufacturer. Only manufacturers approved by Division 260000 will be accepted. All starters shall comply with Division 260000 requirements.

D. Manual Control:

1. Furnish maintained-contact push buttons and pilot lights, properly arranged for single-speed or multi-speed operation as indicated.
2. Furnish manual switch and pilot light for motors 1/3 horsepower and smaller, except where interlock or automatic operation is indicated.

E. Automatic Control:

1. Furnish magnetic starters for motors 1/2 horsepower and larger and for smaller motors where interlock or automatic operation is indicated. Include the following:

a. Maximum number of auxiliary contacts available: three or more.
b. "Hand-Off-Automatic" switches in starter cover.
c. Interlocks, pneumatic switches and similar devices as required for coordination with the control requirement specified in Section 230900-Electronic Controls.
d. Built-in 120 volt control circuit transformer, fused from line side, where service exceeds 240 volts.

1) Control circuit conductors to be protected in accord with the National Electrical Code.

e. Trip-free thermal overload relays, each phase.
f. Externally operated manual reset except on refrigeration compressors which shall have automatic reset. Automatic reset shall be limited to three attempts. If motor fails to start after three attempts, manual reset shall be required.
g. Undervoltage release or protection.
h. Phase failure/phase reversal protection on all legs.

F. Weather Protection: Provide weather-proof mounting of magnetic starters for equipment outside of the building.

G. Note that some starters are furnished and installed under Division 26.

2.3 ACCESS DOORS

A. Furnish access steel access doors, minimum size required for normal service use or as sized on drawings as manufactured by Inryco/Milcor, where shown on mechanical or architectural drawings, and where required for access to valves, shock absorbers, dampers, mechanical equipment or appurtenances.

B. Standard Doors:

1. Frames: 16 ga. steel.
2. Panels: 14 ga. steel.
3. Finish: Chemically bonded prime coat of baked enamel.
4. Hinge: Concealed spring hinges openable to 175 degree; removable pins. Provide number of hinges as recommended by manufacturer for size of door.
5. Locking Devices: Flush steel, screwdriver operated, cam type locks. All access doors below 8'-0" in public areas shall be key-operated cylinder lock with two keys. Same key shall open all access doors.
6. Style of doors shall be appropriate for architectural finish at door location. Furnish masonry anchors where required.

C. Fire Rated Doors:

1. Frames: 16 ga. steel.
2. Panels: Sandwich type, 20 ga. steel sheets, manufacturer's standard insulated core.
3. Finish: Chemically bonded prime coat of baked enamel.
4. Hinge: Continuous type, steel with stainless steel pin.
5. Closer: Automatic closing mechanism.
6. Locking Devices: Self-latching, key-operated cylinder lock with two keys; interior, latch release mechanism.
7. Style of doors shall be appropriate for architectural finish at door location.
8. Fire rated doors shall have components and assemblies meeting requirements of the American Insurance Association, Factory Mutual Insurance Association and listed by Underwriters Laboratories, Inc.

D. Exact location of access doors shall be as directed by Mechanical Contractor and approved by the Architect.

E. Doors shall be installed by the General Contractor.

F. Access doors are to be lockable in public places.

2.4 VALVES

A. General:

1. Provide valves as specified herein and as indicated on the Drawings complete with accessories and attachments as required and appropriate for the pressure/temperature of system.
2. Supply valves for proper pressure ratings determined by the system working pressures at point of use and of proper types for systems and functions indicated.
3. Steam and Condensate System Isolation Valves: Use steam rated ball valves on pipe sizes 2” and smaller. Use gate valves on pipes larger than 2”. Use globe valves on manual bypass lines.

4. Provide like type valves of one manufacturer only unless specified otherwise.
5. Plainly and permanently mark valves with manufacturer's name or trademark, pressure rating, both Cold Working Pressure (CWP) and Steam Working Pressure (SWP), as applicable and flow direction when required to prevent improper installation.
6. Mark valves requiring approval by Underwriter's Laboratories (UL) or Factory Mutual Engineering Division (FM) with appropriate markings cast into the valve body.
7. Provide extended necks as appropriate for insulation.

B. Manufacturers:

1. The following manufacturers are acceptable providing the product to be considered is equivalent in every respect to the nomenclature provided by the specified make and model.

   a. Bronze Valves: Powell, Milwaukee, Crane, Hammond, Nibco.
   b. Iron Body Valves: Powell, Milwaukee, Traverse City, Kennedy, Iowa, American, Nibco.
   c. U.L., F.M. Approved or Listed Valves: Nibco, Demco, Pratt, Kennedy, Mission, Milwaukee, Hammond.
   d. Ball Valves: Hammond, Watts, Jamesbury, Worcester, Milwaukee, Apollo, Powell, Dynaquip, Nibco, Spirax Sarco.
   e. Butterfly Valves: Milwaukee, Hammond, Centerline, DeZurik, Fisher, Victaulic, Keystone, Posi-Seal, TEC, Flowseal, Nibco, IFC.
   f. Lubricated Plug Valves: Homestead, Nordstrom, Powell.
   g. Non-Lubricated Eccentric Plug Valves: DeZurik.
   h. Stop and Drain and Drain Valves: Milwaukee, Hammond, Prier, Nibco or United Brass.
   i. Gas Cock: Peter Healy or Crane.
   j. Check Valves: Nibco, IFC.

C. Valve Schedule:

1. Standard Bronze Valves - 150 SWP/300 CWP, per ASTM B61/B62. No brass materials will be accepted.

   a. Check, Gate, and globe with union bonnet and rising stem.
   b. Sizes 1/8 through 2 inches.
   c. Schedule:

Plan Code:	G.V.	GL.V.	C.V.	L.C.V.
Valve Type:	Gate	Globe	Swing	Lift
Make:	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-134	T-235Y	T-433Y	365.5
Straight Soldered:	S-134	S-235Y	S-433Y	--
Angle Threaded:	--	T-335Y	--	--
Angle Soldered:	--	--	--	--

2. Standard Bronze Valves - 300 SWP/600 CWP, per ASTM B61/B62, no brass materials will be accepted.

   a. Gate, globe and check.
   b. Sizes 1/8 through 2 inches.
   c. Schedule:

Plan Code	G.V.	GL.V.	C.V.	L.C.V.
Valve Type:	Gate	Globe	Swing	Lift
Make:	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-134	T-235Y	T-433Y	365.5
Straight Soldered:	S-134	S-235Y	S-433Y	--
Angle Threaded:	--	T-335Y	--	--
Angle Soldered:	--	--	--	--

3. Standard Iron Body Valves - 125 SWP/200 CWP.

   a. Gate, globe and check.
   b. Sizes 2-1/2 through 12 inches.
   c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	W.C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Weighted	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-619	T-617-0	T-718B	T-918Y	T-918YBLW	--
Straight Flanged:	F-619	F-617-0	F-718B	F-918Y	F-918YBLW	23
Angle Threaded:	----	----	T-818B		----	----
Angle Threaded:	----	----	F-818B	----	----	----

4. Standard Iron Body Valves - 150 SWP/300 CWP.

   a. Gate, globe and check.
   b. Sizes 2 through 12 inches.
   c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Crane (Chapman)
Straight Threaded:	T-669	T-667-0	--	--	--
Straight Flanged:	F-669	F-667-0	F-768B	F-968B	223
Angle Threaded:	--	--	--	--	--
Angle Flanged:	--	--	F-868B	--	

5. Standard Iron Body Valves - 250 SWP/500 CWP.

   a. Gate, globe and check.
   b. Sizes 2 through 12 inches.
   c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-669	T-667-0	--	--	--
Straight Flanged:	F-669	F-667-0	F-768B	F-968B	223
Angle Threaded:	--	--	--	--	--
Angle Flanged:	--	--	F-868B	--	--

6. UL and FM Approved Valves.

   a. Gate, check and butterfly.
   b. Sizes all.
   c. Schedule:

Plan Code:	OS&Y	C.V.	W.V.C.	BF.V	D.V.
Valve Type:	Gate	Swing	Wafer	BTFY	Drain
Make:	Nibco	Nibco	Nibco	Demco	Nibco
Straight Threaded:	T-104-0	T-413W	--	--	T-211Y
Straight Flanged:	F-607-0	F-908-W	--	--	--
Wafer:	--	--	W-900-W	NE-H	--

7. UL and FM Approved Valves - 175 Pound Water.

   a. Post indicator with indicator post.
   b. Sizes 4 through 12 inches.
   c. Schedule:

Plan Code:	P.I.V.	P.I.V.B.F.
Valve Type:	Gate	BTFY
Make:	Nibco	Demco
Straight Flanged:	F-609	NE-H (Wafer)
Mechanical Joint:	M-609	--
Indicator Post Vertical:	NIP-1	Stem extension and gear operator with post indicator U.L. Listed only.
Indicator Post through Wall:	NIP-2	--

8. Underground Valves - 175 Pound Water, American Water Works Association (AWWA).

   a. Gate valves with service boxes.
   b. Sizes (see schedule).

c. Schedule:

Plan Code:	GV & SB	GV & SB
Size/Inches:	3/4 thru 2	2 thru 16
Valve Type:	Oriseal	Gate
Make:	Mueller	Mueller
Model:	H-15201	A-2380-22 or 2380-18
Service Box:	H-10396-86	H-10357
Base:	H-10396-7-8-9 or H-10400	No. 6 Oval
Key:	Stationary rod attached.	A-24610 Furnish one each box.

9. Ball Valve:

a. Blowout proof stem.
b. Full port type with appropriate seals and seat, as specified.
c. Bronze bodies per ASTM B61/B62 or ASTM B-584. No brass material will be accepted.
d. Stainless steel bodies per ASTM A-351, Grade CF3M.
e. Schedule:

Plan Code:	B.V.	B.V.	H.V.	S.B.V.
Service:	Balancing	In line control and isolation	Refrigeration	Steam and Steam Condensate
Pressure:	150 SWP/300 CWP	150 SWP/300 CWP	500 CWP	150 SWP
Sizes/Inches:	1/4 thru 2-1/2	1/4 thru 3"	3/8" thru 2 1/8"	½" thru 2"
Make:	Nibco	Nibco	Nibco	Nibco
Straight Threaded:	T-580-70-66	T-585-70-66	--	T-595-Y-S6R-66
Straight Solder End:	S580-70	S585-70	S595-Y-66	--
Actuator:	Lever with memory stop	Lever	Lever	Lever
Port:	Standard	Full	Full	full

* Steam ball valve includes a three-piece body, seals rated for steam operating temperatures up to 400°F.

10. Butterfly Valves:

a. Schedule; standard 150 psi with 150 psi ANSI companion flanges for use where system pressures cannot exceed 200 psig shut off (static) pressure.

Plan Code:	BFV		
Style:	Semi-lug wafer body		
Pressure Rating ANSI Class:	150 minimum		
Body:	Cast Iron		
Disc:	Aluminum Bronze		
Stem:	316 Stainless	18-8 Stainless	17-4 PH Stainless
Seat:	EPDM (-40 deg.F to 250 deg.F)		
Actuator:	2" thru 5" Infinite position lever with memory stop. 6" thru 24" Self-locking worm gear with adjustable limit stops, and position indicator. Provide chain wheel and chain where indicated by contract documents or where valve is located more than 8” above floor.		
Make:	Keystone		
Size:	2"-12"	14"-20"	24-36
Model:	228	122	AR1

b. Schedule: High performance 300 psi with 300 psi ANSI companion flanges for use where system pressures are more than 200 psig but cannot exceed 700 psig shut-off (static) pressure.

Plan Code:	BFV	
Style:	Lug	
Pressure Rating ANSI Class:	300 minimum	
Body:	Carbon steel ASTM A-216	
Disc:	316 stainless steel ASTM A-216	
Stem:	Stainless steel ASTM A564 Type 630 (17-4PH)	
Seat:	Virgin TFE	
Actuator:	3" and 4": Rachet handle with lock. 6 and over: Worm gear with lock.	
Make:	Flowseal (Mark Controls Corp.)	
Size:	3" and 4"	6" and over
Model:	XX-3L-121TTH-L	XX-3L-121TTH-2

11. Stop Check Valve:

    a. Schedule:

Plan Code:	S.C.V.
Pressure:	250 SWP/500 CWP
Size/Inches:	2-1/2 thru 10"
Make:	Crane
Straight Flanged:	28E
Angle Flanged:	30E

12. Eccentric Plug Valve:

    a. Schedule:

Plan Code:	E.P.V.	E.P.V.
Pressure:	175 lb. CWP	175 lb. CWP
Size/Inches:	1/2 thru 3	4 thru 8
Make:	DeZurik	DeZurik
Model:	400	100
Actuator:	483-487	159 w/Memory Stop
Ends:	Threaded	Flanged

13. Gas Valves:

    a. Gas cock and lubricated plug.
    b. Schedule:

Plan Code:	G.C.K.	L.P.V.	L.P.V.	G.B.V.
Pressure:	100 PSI Air	200 lb. CWP	200 lb. CWP	250 PSI LP-Gas
Size/Inches:	1/2 thru 1	1/2 thru 3	4 thru 12	1/4" thru 3"
Make:	Peter Healy	Walworth	Walworth	Apollo
Model:	1500-F	1700	1707-F	80-100
Actuator:	None	E-2	Wrench as required	1/4 turn
Ends:	Threaded	Threaded	Flanged	Threaded

14. Specialty Valves:

    a. Petcock, stop and drain, drain, needle.

b. Schedule:

Plan Code:	PTK	S&D.V.	D.V.	N.V.
Type:	Petcock	Gate	Ball	Needle
Pressure:	250 LB.	125 LB.	125 LB.	200 LB.
Size/Inches:	1/8	1/2 and ¾	3/4	1/8 thru 3/4
Make:	Powell	Nibco	Apollo	Jenkins
Model:	922	76 or 726	78-104	743G
Ends:	Threaded	Threaded or Soldered	Threaded and Hose End Adaptor	Threaded

2.5 PIPE HANGERS, SUPPORTS, AND ACCESSORIES PROTECTION

A. General:

1. Provide hangers, rods, clamps, brackets, attachments, inserts, bracing, nuts, coach screws, eye bolts, clips, plates, and washers as required for appropriate installation for building structure provided.
2. All hangers and accessories shall be manufactured by one manufacturer for compatibility of all components.
3. All hangers, attachments, and accessories shall be provided with a certified manufacturers safety factor of five (5).
4. All hangers, attachments and accessories shall comply with the following:

   a. Safety factor of 5 (actual load vs. ultimate load).
   b. National Fire Protection Association (NFPA) (except as amended by provisions of this Specification for minimums) and as applicable.
   c. Factory Mutual Engineering Division (FM) as applicable.
   d. Manufacturers Standardization Society (MSS).

5. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42-96.

B. Material:

1. Hangers in contact with steel, iron, cast or ductile iron shall be hot dipped galvanized or cold galvanized with "Galvilite by ZRC" cold galvanized compound only to a thickness of not less than 3.0 mil (.003 inches). "Galvilite by ZRC Worldwide, Marshfield, MA. Tel: (800) 831-3275, www.zrcworldwide.com" or equal.
2. Hangers in contact with copper piping shall be copper clad or provided with heavy density felt (20 oz.) pad permanently attached to the hanger and placed so as to prevent direct contact between pipe and hanger. Felt shall be mildew and moisture rot-proof. Heavy polyvinyl chloride coating on hanger, 5 mil thickness minimum will be acceptable in lieu of felt.
3. Hangers in contact with "plastic" or "glass" piping shall be galvanized in accordance with Sub-paragraph B-1, above and padded in accordance with Sub-paragraph B-2, above.

4. Hangers for insulated piping shall be provided on all piping of this size with insulation shields or insulation saddles* as applicable and appropriate and in accordance with the following schedule:

Nominal Pipe or Tubing Size	Shield Length	Shield Gauge Thickness	Material
½" thru 3"	12"	18	Galvanized
4"	12"	16	Galvanized
5"	15"	16	Galvanized
6"	18"	16	Galvanized
8"	24"	--	B-line (B3160-3165)
over 8"	36"	--	B-line (B3160-3165)

* Insulation inserts between piping and shield shall be furnished by 230700 Contractor for appropriate pipe size and insulation thickness for all insulated piping requiring a vapor barrier.

5. Provide swivel ring hangers similar and equivalent to B-Line B-3170, 3170CT, and 3170C for pipe sizes 1/2" thru 8".
6. Clevis type hangers may, at the Contractors option, be provided when similar and equivalent to B-Line B-3100, and 3100C.
7. Roller type hangers shall be used on all steam piping 4" and larger and when appropriate shall be equivalent to B-Line B-3110 black steel with cast iron roller. Provide insulation saddles for all roll-type hangers, B-Line B3160-3165. Calcium silicate inserts, in conjunction with insulation saddles shall be provided on all steam piping.
8. Beam and bar joist clamps shall be appropriate for attachment locations, top beam, bottom beam, etc., and provided with retainer rods, clips or straps as required.
9. Hanger spacing and minimum rod sizes shall be based on the applicable Mechanical and Plumbing Codes for the type of piping installed.
10. Riser clamps shall be provided on all vertical risers at each floor and shall conform to materials and protective coatings or pads as specified in Paragraph B of this Article 2.05. Clamps shall be similar and equivalent to B-Line B-3131 and B-3148.
11. Provide concrete inserts where required in flat slab construction similar and equivalent to B-Line B-22-1 Series 2000 lbs. per foot load capacity and spaced per hanger spacing schedule (sub-paragraph B-9 above) provide all accessories and nuts required.
12. Trapeze hangers shall be constructed of channel similar and equivalent to B-Line Series B-11 thru B-72 as appropriate complete with pipe clamps, nuts, rollers etc., as required. Channel to bear 5 times actual weight of all piping on trapeze system with minimum deflection. (.01 inch maximum). At a minimum, install pipe clamps on every other trapeze hanger, and where required to comply with seismic restraint design.
13. Wall brackets shall be fabricated "knee" brackets conforming to requirements of sub-paragraph B-12 above and made up with B-Line Series B-11 thru B-72 channel. Angle clips may be used in wood joist construction when similar and equivalent to B-Line B-3060 or 3061.

14. Hangers attached to wood construction shall be attached by use of eye bolts, coach screws or lag bolts when load bearing ratings maintain a safety factory of 5.
15. All other means of support i.e., special construction, pipe stands, earthquake bracing, sway bracing, etc., shall be provided as required and in conformance with jurisdictional authority and these Contract Documents, submit all special or required support and bracing systems for review by the Architect/Engineer prior to installing any item.
16. All vertical refrigeration suction and hot gas, and all steam piping shall be provided with insulation shields and calcium silicate inserts at each support location.
17. All piping systems exposed to motorized traffic shall be fully protected by installation of concrete-filled pipe bollards. Bollards shall be cleaned and painted as directed by the Architect.
18. For plenum applications use pipe supports that meet ASTM E-84 25/50 standards.

C. Acceptable Manufacturers:

1. Manufacturers acceptable to this Specification are as follows, all other manufacturers must submit for acceptance.

   a. B-Line
   b. Fee & Mason
   c. Grinnell
   d. Hubbard Enterprises/HOLDRITE
   e. P.H.D.
   f. Michigan
   g. Tolco

2.6 IDENTIFICATION MATERIALS FOR PIPING AND EQUIPMENT

A. Materials for identification shall be as follows:

1. Metal Tags: Round brass discs, minimum 1-1/2" diameter with edges ground smooth. Each tag shall be punched and provided with brass chains for installation.
2. Engraved Nameplates: Fabricate from plastic sheet stock of sufficient thickness to allow engraved lettering in contrasting color. Attach nameplates to equipment with screws.
3. Painted Stencils: Of size and color per ANSI A13.1 using clean cut letters and oil base paint. Paint material shall comply with Architectural Painting Specifications. See Part 3 for legend and size for Stencils.

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
3/4" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
over 10"	32"	3-1/2"
Ductwork and Equipment	NA	2-1/2"

2.7 FREEZE PROTECTION SYSTEMS FOR PIPING AND EQUIPMENT (HEAT TRACING)

A. General:

1. Provide freeze protection for all water, sewer, sumps, tanks, pumps, equipment drains, etc., where piping and equipment are subject to ambient temperatures of less than 35 deg.F, and as indicated on Contract Drawings.
2. Approved Manufacturers: Raychem, Thermon.
3. Freeze protection shall consist of electrical self regulating semi-conductive "core" heat cable complete with all accessories including but not limited to an adjustable thermostat sensing the pipe or vessel contents temperature in lieu of ambient sensing, and contactors to enable power to the heat cable when temperature is below thermostat setpoint.
4. The self-regulating heater shall consist of two (2) 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed over itself without overheating, to be used directly on plastic pipe, and to be cut to length in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.

   (Optional: For installation on plastic piping, the heater shall be applied using aluminum tape (AT180). To provide a good ground path where none exists and to enhance the heater's ruggedness, the heater shall have an outer braid of tinned-copper and an outer jacket of modified polyolefin (-CR).

5. In order to provide energy conservation and to prevent overheating, the heater shall have a self-regulating factor of at least 90 percent. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heater output going from 40°F pipe temperature operation to 150°F pipe temperature operation.
6. The heater shall operate on line voltages of either 120 or 208-277 volts without the use of transformers.
7. Heater shall operate from a circuit breaker for each tracing circuit.
8. The heat tracing shall maintain minimum "contents" temperature of 40 deg.F at ambient temperature of -20 deg.F when enclosed within a minimum of 1" fiberglass insulation on piping and vessels and pumps, no insulation required on sumps, etc., unless otherwise indicated.
9. Installation:

   a. Apply the heater linearly on the pipe after piping has been successfully pressure tested. Secure the heater to piping with cable ties or fiberglass tape.
   b. Apply "electric traced" signs to the outside of the thermal insulation.

10. Tests:

    After installation and before and after installing the thermal insulation, subject to testing using a 2500 VDC megger. Minimum insulation resistance should be 20 to 1000 megaohms regardless of length.

B. Manufacturers:

1.	Manufacturer:	Raychem	Raychem	Raychem
2.	Product:	Chemelex	Chemelex	Chemelex
3.	Trade Name:	XL-Trace	XL-Trace	XL-Trace
4.	Pipe Size:	½”-3”	½” - 3”	4” & Larger
5.	Product No.:	5XL-1	5XL-2	8XL-2-CR
6.	Voltage:	120V	277V	277V
7.	Max Circuit Length:	270 Ft.	470 Ft.	350 Ft.
8.	Thermal Rating:	5 Watts/Ft.	5 Watts/Ft.	8 Watts/Ft.
9.	Connection:	RAYCLIC-PL	RAYCLIC-PL	RAYCLIC-PL
10.	Splice Kit & Tee Kit:	RAYCLIC-T	RAYCLIC-T	RAYCLIC-T
11.	End Seal Kit:	RAYCLIC-S	RAYCLIC-S	RAYCLIC-S
12.	Thermostat:	RAYCLIC-E	RAYCLIC-E	RAYCLIC-E
13.	Glass Cloth Adhesive Tape:	GT-66	GT-66	GT-66

C. Responsibilities:

1. Heat trace including all accessories shall be furnished as part of the Work included in Division 23. Installation of cable on pipe including splices, strapping and bulb placement shall be by Division 23 Contractor.
2. Installation of power wiring including breakers and mounting thermostat enclosure shall be part of the Work included in Division 26.
3. Work under Division 23 includes coordination of material quantity and delivery, tracing installation, and insulation of piping after heat trace has been installed, inspected and tested.

2.8 DIELECTRIC PIPE FITTINGS AND ISOLATORS

A. Manufacturer: Epco Sales Inc., Victaulic.

B. Schedule: (complete unions)

Model:	FX	GX
Sizes:	½" thru 2"	2" thru 12"
Maximum Pressure:	250 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F
Epconite Gasket:	#2	#2
Ends:	FPT x Solder	FPT x Solder
Type:	Union	Flanged Union

C. Schedule: (companion flanges)

Model:	X	W	H
Sizes:	1-1/2" - 10"	1-1/2" - 12"	1-1/2" - 12"
Maximum Pressure:	175 psi	175 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F	210 deg. F
Epconite Isolators:	#2	#2	#2
End Style:	Solder (Brass)	Weld neck	Iron Pipe Thread
Type:	Companion	Companion	Companion
Face Gasket:	Same as Isolators		

D. Dielectric fittings shall conform to ASA B16.8, and shall be plated as applicable a minimum of .0005" and have no flow restriction when assembled.

2.9 SOLVENTS FOR PLASTIC PIPING

A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule 1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

2.10 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tubing: ASTM B88, Type M, hard drawn.

1. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.29 solder wrought copper.
2. Joints: ASTM B32, solder, Grade 95TA.

2.11 ELEVATOR SHAFT ROOF VENT

A. Approved Manufacturers: Bilco, Dur-red, or approved equal.

B. Covers shall be 14 gauge paint bond galvanized steel with 3" beaded flange neatly welded. Insulation shall be glass fiber 1" in thickness, fully covered and protected by a 22 gauge galvanized paint bond steel cover liner. Curb shall be of 14 gauge galvanized paint bond steel, 12" in height on hinge sides, with a 5° pitch to the fixed center channel. Curb shall be formed with a 3-1/2" flange with holes for securing to the roof deck and with an integral metal capflashing of the same gauge and material as the curb, full welded for weathertightness. Insulation on the exterior of the curb shall be rigid fiberboard 1" in thickness. All hardware shall be cadmium plated and factory finish shall be red oxide paint on steel.

C. Vent shall be completely assembled with heavy pintle hinges, compression spring operators, neoprene draft seal, heavy duty shock absorbers and pull handles for inside and outside operation. <It shall open automatically when heat breaks the 165°F fusible link and shall be labeled as being FM Approved, UL Listed>. Installation shall be in

accordance with manufacturer's instructions. Manufacturer shall guarantee against defects in material and workmanship for a period of five years.

D. Vent shall be provided with electrically actuated fusible link to melt upon receiving current from smoke detector. Mechanical contractor shall provide photoelectric smoke detector with auxiliary contacts, transformer and wiring to fusible link. Mount smoke detector on inside of elevator shaft and in each elevator lobby.

E. Provide owner with replacement fusible links (2 per roof vent) for both fire and smoke testing.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. General: Unless otherwise specifically indicated on Drawings or in Specifications, install equipment and materials in accordance with recommendations of manufacturer, including performance of tests as manufacturer recommends. Install all equipment, valves, etc. to be accessible and maintainable without any extreme or unusual effort such as removing duct, air handlers, structure, etc.

B. Protection:

1. Close ends of pipe and ductwork during construction and cover equipment to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Cover floor drains and protect fixtures and equipment against damage during concrete pours and mechanical work.

C. Quiet Operation and Vibration:

1. All work shall operate in accordance with Section 230540 - Mechanical Sound and Vibration Control under all conditions of load.
2. Sound or vibration conditions not in accordance with Section 230540 and considered objectionable shall be corrected in a manner approved by the Architect under the Work of Division 23.

3.2 WELDING

A. Joints between sections of pipe, between pipe and fittings, shall be fusion welded. Use only certified welders. Strength of finished welded joints to be equal to strength of pipe. Width of finished weld to be at least 2-1/2 times the thickness of the part joined. Thickness of weld to be at least 25% greater than the thickness of pipe or fittings. Finished welded joints to present neat and workmanlike appearance.

B. Make no direct welded connections to valves, strainers, apparatus, and related equipment. Make connections to flanged valves, and flanged equipment with welded pipe connection flanges.

C. Radii of weld ells to be 1-1/2 times nominal diameter of fittings. Fittings used for all branch connections, whether full-size or reducing, to have interior surfaces smoothly contoured. Wall thickness of welded fittings equal to adjacent piping.

3.3 ELECTRIC WIRING

A. Furnish equipment requiring electrical connections to operate properly and to deliver full capacity at electrical service available.

B. All control wiring to be in accordance with manufacturer's recommendations; all wiring shall be color coded to facilitate checking.

C. Unless otherwise indicated, all mechanical equipment motors, starters, and controls shall be furnished, set in place, and wired in accordance with the Electrical Equipment/Wiring Responsibility Matrix on the drawings. Contractor should note that the intent of this electric wiring matrix is to have the Division 23 Contractor responsible for coordinating all control wiring as outlined, whether or not specifically called for by the mechanical or electrical drawings and specifications. Mechanical Contractor shall comply with the applicable requirements of Division 26 for electrical work of this Division 23 which is not otherwise specified. No extras will be allowed for Contractor's failure to provide for these required items. The Division 23 Contractor shall also refer to the Division 26 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

ELECTRICAL EQUIPMENT/WIRING RESPONSIBILITY MATRIX

Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Equipment Motors	MC	MC	EC	MC
Motor Starters & Overload Heaters	MC – Except when shown on MCC	EC	EC	MC
Variable Frequency Drives (VFD's)	MC	EC	EC	MC
Fused & Unfused Disconnect Switches, Thermal Overload & Heaters	EC	EC	EC	--
Manual Switches & Speed Control Switches carrying full load currents.	MC	EC	EC	EC
Fire/Smoke and Smoke Dampers	MC	MC	EC – Requires emergency power circuit if air system served is on emergency power.	EC
Control Relays & Transformer (See Note 2)	MC	MC	EC	MC
Thermostats (Line Voltage)	MC	EC	EC	EC
Temperature Control Panels	MC	MC	EC	MC
Building Fire Alarm System Fire & Smoke Detectors, including Relays in Starters for Fan Shutdown.	EC	EC	EC	EC
DDC Interface to Fire Alarm System	MC	MC	EC	MC

Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Electric Plumbing Fixtures, Sensor Faucets, Sensor Flush Valves, Electric Water Coolers, and required Transformers.	MC	MC	EC	MC
Motor & Solenoid Valves, Damper Motors, PE & EP Switches, Control Valves, Low Voltage Thermostats	MC	MC	MC	MC
Pushbutton Stations & Pilot Lights (manually operated switches not carrying load currents).	MC	MC	N/A	MC
Pushbutton Stations & Pilot Lights carrying fully load current.	MC	EC	EC	N/A
Exhaust fans for kitchen hoods or fume hoods where interlocked with make-up air fans.	MC	MC	EC	EC
Exhaust fans when switched with room lights.	MC	MC	EC	EC
Boiler Controls including Gas Train	MC	MC	EC	MC
Fire sprinkler system alarms, tamper switches, flow switches and fire alarm systems tie-ins to provide a complete fire protection system.	FPC	FPC	FPC	FPC
Water Softener Timeclocks, Timers, Lock-out Devices, Wheatstone Bridges and Meters	MC	MC	EC	MC
Temporary Heating Connections	MC	MC	EC	MC
Freeze Protection Heat Cable	MC	MC	EC	MC
Heat Maintenance Cable	MC	MC	EC	--
HVAC Water Treatment Interlocks and Glycol Pumps	MC	MC	EC	MC
Cooling Tower Level Control and Fan Vibration Switch	MC	MC	MC	MC
Cooling Tower Sump Heaters	MC	MC	EC	MC

* MC = Mechanical Contractor under Division 23 of the work.
* FM = Mechanical Contractor under Section 212200 - FM-200 Fire Suppression System.
* FPC = Fire Protection Contractor.
* EC = Electrical Contractor under Division 26 of the work.

D. All temperature control conduit and wiring shall be furnished and installed under Section 230900. All motorized damper and motorized valve wiring shall be furnished and installed under Section 230900.

3.4 SLEEVES, PLATES AND CLOSURES

A. Division 23 Contractor shall provide and locate pipe sleeves, and inserts 1” larger, clear dimension, than the outside of the pipe, required before new floors and walls are built or shall be responsible for the cost of cutting and patching required where sleeves and inserts were not installed or where incorrectly located. Sleeves for insulated piping shall be large enough to allow the covering to pass through the sleeve. Caulk or seal as required to make sure water does not penetrate through sleeve.

B. Provide sleeves for mechanical piping passing through concrete floor slabs and through concrete, masonry, tile, and gypsum wall construction. Provide metal collars to close and protect openings.

C. Where sleeves are placed in exterior walls below grade, pack spaces between the pipe or conduit and the sleeves with Hornflex Thiokol L-32 Sealant or Link Seal and make water-tight. Provide metal rodent collars securely fastened to structure. Link seal shall not be used on fire lines.

D. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe only and the insulation shall be made to butt against the construction, except for pipes requiring insulation having a vapor barrier, in which case, the sleeves shall be large enough to pass the pipe and insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations, make actual lengths to suit the following:

1. Terminate sleeves flush with floors, walls, partitions, and ceilings.
2. Seal annular space around pipes watertight at floor penetrations.
2. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor.
3. In all areas where pipes are exposed, extend sleeves 1/4" above finished floor, except in rooms having floor drains, where sleeves shall be extended 2" above floor and in Kitchens and Mechanical Equipment Rooms, where sleeves shall be extended 4" above floor.

C. Sleeves shall be constructed of 24 gauge galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated on the drawings. "Crete Sleeve" (plastic type) sleeves are acceptable for concrete construction as manufactured by Sperzel Division, Shamrock Industries or Willoughby Industries.

D. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is placed or when other construction is built around them.

E. Provide tight fitting floor and ceiling plates on pipes passing thru walls, ceilings, and floors. Nickel or chrome plated in finished areas, galvanized cast iron in unfinished areas. Provide wall and ceiling flanges for ducts in finished areas.

F. Provide all cutting, patching of holes, openings, notches. Obtain written approval for notching, boring, chipping, burning, drilling, welding to structural members in accordance with the General Conditions of the Contract <and paragraph 3.7 of this Section>.

G. Where pipe sleeves penetrate fire rated walls and floors, this contractor shall use fire safing to seal openings.

3.5 FOUNDATIONS, PADS AND CURBS

A. Provide dowels, anchor bolts, groutings, concrete foundations and pads for pumps, plumbing, heating and ventilating or air conditioning equipment in accordance with Concrete Specifications.

B. Dimensions and exact locations for foundations and concrete curbs for mechanical equipment to be field verified and located accurately by Division 23 Contractor.

C. When water heaters and similar equipment are installed in a suspended application, an engineered and manufactured platform shall be used. Weight loading capability shall include a minimum safety factor of 2.

3.6 EXCAVATING AND BACKFILLING

A. Excavate for all mechanical equipment such as fuel tanks, ductwork, sump pumps, manholes and trenches for underground pipelines to required depths. Compact bottoms of excavations. Slope to obtain required grade. Remove rocks, trash and debris before installation of equipment and backfilling. Backfill by hand tamping earth under the haunch of the pipe to specified compaction. Backfill and compact in thin layers until top of pipe is covered. Complete backfill by methods required or directed for soil characteristics to comply with the Architectural section of these specifications.

B. Excavations near footings shall be such that, when nearing building footings, or bearing foundation walls, the excavation bottom shall not be nearer the footing than a normal 45 degree bearing line from edge of footing bottom to bottom of excavation. When it is necessary to perpendicularly cross under a continuous foundation wall, care shall be taken to insure that crossing is clear of the structural foundation and of minimal width.

C. Do not place backfill over pipe lines until lines are properly tested.

D. When trenching through specially tested areas, such as paving, asphalt, etc., Contractor shall be responsible for restoring the surface to its original condition, and in a manner approved by the Architect. Repair trenches where settlement occurs, and restore the surface for the period of one year after final acceptance of the project. All cutting of paving, asphalt, etc. shall be by saw cutting.

3.7 CUTTING AND PATCHING

A. Openings in New Construction:

1. Provisions for New Openings: The Division 23 Contractor shall verify all openings required in the new construction in connection with the work under Division 23 with the Architectural and Structural Drawings and shall then meet with and verify same with the General Contractor/Construction Manager who will assign the work to the appropriate contractor to provide all openings in the new construction of the correct size and location in walls, floors or through roofs required for the installation of the mechanical work.

B. Cutting in New Construction:

1. Failure on the part of the Division 23 Contractor to make the above arrangements for required openings shall cause the cost of cutting and patching for the necessary openings for the installation of his work to be borne by him, either by being assigned to the General Contractor/Construction Manager or in the form of performing the required cutting himself. In either case, all patching shall be done by the appropriate finishing contractor as determined by the General Contractor/Construction Manager. No cutting or drilling of holes shall be done without approval of the Architect/Engineer.

C. Patching in New Construction:

1. The appropriate finishing contractor as determined by the General Contractor/Construction Manager shall patch all openings in the new structure. All openings made in fire rated walls, floors, or ceilings, shall be patched and made tight to conform to the fire rating for the enclosure. All materials used in patching shall match the materials specified in the Architectural Specifications and all patched areas shall be restored to the specified finish surface to the satisfaction of the Architect.
2. The Division 23 Contractor shall pay the appropriate Finishing Contractor as determined by the General Contractor/Construction Manager for all patching resulting from cutting to accommodate mechanical work.

D. Cutting in Existing Building:

1. The Construction Manager/General Contractor shall make arrangements for required openings in the existing building to facilitate the passage of ductwork, piping, etc. thru existing floors, walls, and beams. Division 23 Contractor to coordinate all requirements.

E. Patching in Existing Building:

1. The Construction Manager shall provide for patching all existing walls and floors to match existing.

3.8 PIPE HANGERS/SUPPORTS

A. Use inserts, anchors, expansion bolts or other approved and acceptable means of attachment to concrete construction. Set inserts in advance of concrete installation, provide required reinforcement rod for all inserts carrying loading equivalent of one 4" pipe or more. All inserts shall be flush with face of slab or wall containing insert.

B. Provide flat square washers for rods thru metal decking with nut above washer, when acceptable and approved.

C. Cinch hangers to carry appropriate share of loading and slope piping without sags or "pocketing" as appropriate and required.

D. Rod offsets, or angle installation, plumber tape or wire will not be accepted. Hanger rods shall be true and plumb.

E. Piping shall not be hung from other piping or equipment items. Provide attachments to building structure only. Use trapeze, wall brackets, knee brackets, etc., where hanger rods cannot be attached within spacing plumb to structures.

F. Provide sway and earthquake bracing where required in accordance with Section 230548 - Mechanical Seismic Control.

3.9 INSTALLATION OF VALVES

A. General:

1. Provide valves as shown on Contract Documents and as required for pressure relief, balancing and/or control of flow.
2. Provide isolation valves for maintenance and service on each piece of equipment regardless of whether or not shown on Contract Drawings.
3. Provide isolation valves for all branch line take-offs that serve more than two items of fixtures or equipment.
4. Provide balancing valves for each leg of domestic hot water return piping of two branches or more, all heating/cooling water returns and/or supplies to equipment as shown on Contract Documents.
5. Provide access means for each valve or group of valves either by access panels or utilization of inherent access provided by building methods i.e., lift out ceiling construction or exposed valve installations in non critical areas such as janitors closets, storage rooms, etc.
6. Install all valves with valve bonnets or operating stems in vertical (upright) position when possible, valves may be installed with bonnets or stems not less than 35 degrees downward from vertical plane except valves on vertical piping may be 90 degrees from vertical plane. Swing type check valves shall be installed on horizontal piping no more than 45 degrees upward slope from horizontal plane, using lift checks on vertical piping. Lift check valves shall not be used on sewage or sump pump discharge piping.
7. Inspect and tighten all bonnet nuts, bolts, packing glands, lubricate all valves requiring lubrication, secure all hand wheels and identification plates, be responsible for all valves having manufacturers name, trade name, working pressure and size stamped or cast into the body of the valve. Perform all maintenance, repacking and inspection prior to installation of valve.

B. Proper Installation of Valves:

1. Provide valves in accordance with the following schedule unless specified otherwise in Contract Documents.

   a. Dead-end shut off: Gate, ball, butterfly, plug, stop and drain.
   b. Throttling: Ball, plug, globe, diaphragm, needle, butterfly (when using butterfly valves for throttling, additional valves must be provided for service shutoff.)
   c. Backflow prevention: Check.
   d. Water hammer prevention: Silent or pilot operated non slam check.
   e. Gas piping: Lubricated plug (or ground joint cock up to 1" only), or UL-Listed ball valve.

C. Removal and Repair Provisions:

1. Provide all valves which are not accessible for repair without removal from piping with union connection immediately adjacent to valve outlet.

D. Access to Valves:

1. Install all valves, balancing valves and meters in clear open accessible position so valve information and position can easily be read and maintained. Valve position to be reviewed by Campus Project Manager and/or maintenance personnel. If valve is installed without review and valve is determined to be non-accessible by Campus Project Manager, valve to be removed and relocated to new location by this contractor at no additional charge.

3.10 PAINTING

A. Surfaces of exposed equipment and materials to be thoroughly cleaned and left ready for painting in accordance with Architectural Painting Specifications.

B. Duct interiors visible through registers, grilles and diffusers shall be painted flat black.

C. Exposed gas piping to be cleaned, primed and two coats of paint (grey).

D. All other painting of mechanical equipment and piping, unless otherwise noted, shall be performed under other divisions of the work with the exception of identification of piping and equipment which will be the responsibility of the Division 23 Contractor.

3.11 IDENTIFICATION OF PIPING AND EQUIPMENT

A. General: Provide pipe identification, valve tags, stencils, or engraved nameplates to clearly identify the mechanical equipment, piping and controls of the various mechanical systems and direction of flow in piping.

B. Methods for identification shall be as follows:

1. Metal Tags: Stamp tags with letter prefixes to indicate service, followed by a number for location in system.
2. Engraved Nameplates: Attach nameplates with brass screws. Pressure-sensitive embossed labels are not acceptable. Nameplates shall bear the same identifying legend used on the Contract Documents.
3. Painted Stencils: Stenciled markings shall be neatly performed with no overspray, drips, or other imperfections. Pipes and equipment to be stenciled shall first be wiped clean of dirt, dust, rust, grease and moisture. Pipes and smooth, hard surface in the area the stencil is to be applied. Paint application shall comply with Architectural Painting Specifications.

Size of Legend and Letters for Stencils:

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
¾" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
over 10"	32"	3-1/2"
Ductwork and Equipment	NA	2-1/2"

4. Piping Legend and Color (Contractor shall obtain written approval of colors from Owner's representative prior to starting work.)

Legend	Background Color	Direction Arrow	Pressure
Condensate	Yellow	Arrow	PSI
Feed Water	Yellow		
Chilled Water	Light Green	Arrow	
Tower Water	Light Green	Arrow	
Compressed Air	Light Blue		PSI
Blow Down	Yellow		
Domestic Cold Water	Light Green		
Domestic Hot Water	Yellow		
Sprinkler-Fire	Red		
Natural Gas	Orange		
Heat Pump	Yellow	Arrow	
Solar Heated Water	Yellow	Arrow	
Refrigerant Liquid	Yellow	Arrow	
Refrigerant Suction	Yellow	Arrow	
Refrigerant Hot Gas	Yellow	Arrow	

C. Identification of Piping: Identify all piping accessible for maintenance in crawl spaces, above ceilings, and access spaces as well as exposed to view utilizing or stenciled markings according to the following procedures:

1. Use an arrow marker for each pipe-content legend. The arrow shall always point away from the pipe legend and in the direction of flow: color and height of arrow to be same as content legend lettering.
2. If flow can be in both directions, use a double-headed arrow indication.
3. Apply pipe legend and arrow indication at every point of pipe entry or exit where line goes thru wall or ceiling cut.
4. Apply pipe legend and arrow indication within 3" of each valve to show proper identification of pipe contents and direction of flow.
5. The legend shall be applied to the pipe so that lettering is in the most legible position. For overhead piping, apply legend on the lower half of the pipe where view is unobstructed, so that legend can be read at a glance from floor level.
6. For pipes under 3/4" O.D., fasten brass tags securely at specified legend locations.
7. Legend on steam piping, condensate return, compressed air, medical air, gas, and vacuum systems shall include working pressure or vacuum.
8. Insulated piping equipped with electric heat trace shall additionally be labeled “Electric Traced” with label of same size and color as the pipe legend.

D. Valves: All valves, including but not limited to domestic hot and cold water, hot water recirculation, heating water, chilled water, condenser water, steam, steam condensate return, fire protection, gas, medical gas, vacuum and special service valves located inside the building, shall be tagged and identified as to type of service, location number, and normal valve position (normally open or normally closed).

E. Controls: All magnetic starters and relays, shall have nameplates or be stenciled to identify connecting or controlled equipment. All manual operating switches, fused disconnect switches and thermal over-load switches which have not been specified as furnished with indexed faceplates shall also have nameplates or be stenciled as to "connected" or "controlled" equipment. All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays, and starters shall be clearly identified.

F. Pumps: All pumps shall be identified as to service and zones served. Base mounted pumps shall be stenciled or have system served nameplates. Brass tags secured by brass chains may be used on small in-line pumps.

G. Storage Tanks, Water Treatment Equipment and Heaters: All tanks and heaters shall be stenciled as to service. The connecting pipes to each shall be identified and the service temperature entering and leaving the tank or heater shall be indicated.

H. Fans: All supply and exhaust fans and air handling units and connecting ductwork supplying one or more areas from an equipment room or isolated crawl or furred space shall have nameplate or be stenciled as to plan code number, service and areas of zones served.

I. Air Conditioning Equipment: Air conditioning equipment such as chillers, pumps, condensers, or roof-top equipment shall be identified by stencils, or system nameplates.

J. Access Doors: Provide engraved nameplates or painted stencils to identify concealed valves, controls, dampers or other similar concealed mechanical equipment. Obtain Architect approval before installation on all access doors in finished areas.

K. Lift Out Ceilings: Provide engraved nameplates or black lettering on transparent adhesive labels on ceiling tee stem to identify concealed valves, controls dampers or similar concealed mechanical equipment which is directly above nameplate in ceiling space. Obtain Architect approval before installation.

L. Expansion tanks shall be labeled to indicate system served and precharge pressure.

M. Access Flooring: Provide thin engraved nameplate on access panel to indicate location of underfloor fan coils and smoke/fire dampers.

3.12 DRIP PANS

A. Provide drip pans under all fluid conducting piping which runs over electric switchgear, busway, or electric motor starters, and under all point-of-use water heaters.

B. Pans: 18 gauge galvanized iron. Pans shall be two inch deep, with rolled top edges, and shall extend six inches each side of the pipe or group of pipes and six inches beyond the equipment below. Keep pans as close to the underside of the pipes as practicable. All seams shall be soldered, and pans shall be crossbraced as required to prevent sagging and warping.

C. Pitch each pan to a drain connection, and pipe a 1-1/2 inch or larger copper tube drain to discharge over nearest available open drain.

3.13 FIRE SAFING

A. Mechanical Contractor shall provide fire safing for his work as follows: Where fire rated separations are penetrated by pipes, conduit or ductwork, the annular space around the pipe, conduit or ductwork shall be filled with a U.L. Rated fire safing material. Refer to Division 7 for materials and application specifications.

3.14 HEAT MAINTENANCE CABLE AND FREEZE PROTECTION CABLE

A. Comply with National Electric Code Section 427 for installation.

B. Protect heater strips from damage before, during and after installation.

C. Provide waterproof insulation for all heat traced and heat maintained piping one inch thick minimum in accordance with Section 230700.

D. When installing do not twist buss wires together.

E. Test each circuit prior to and immediately after installation of thermal insulation using a megger under 500 volts D.C. Minimum insulation resistance reading shall be ten (10) megohms regardless of length, if less than ten (10) megohms investigate cause and replace damaged sections - do not repair!

F. Install heat cable on lower quadrant of pipe 45 degrees up from vertical, provide ties or fiberglass tape 12" on center max.

G. Install all accessories and kits per manufacturers' recommendations and standards. Careful attention to manufacturers' installation instructions as pertains to valves and equipment will be strictly adhered to and enforced.

3.15 DIELECTRIC PIPE FITTINGS AND ISOLATORS

A. Provide dielectric pipe fittings and isolators at all connections between dissimilar metals in the domestic water, and fire protection systems to control corrosion potential caused by galvanic or electrolytic action.

B. Typical locations for dielectric isolation are; water heaters, storage and pressure tanks, water conditioning equipment, pumps, changes in service piping materials, make-up connections to boilers and chilled water systems, valves, deaerators, flexible connectors and the like where materials of different electrode potential are joined.

C. Hangers for piping shall be isolated per Section 230529 when hanger and piping materials are dissimilar and subject to production of electrolysis or galvanic action.

D. Storage tanks shall be isolated from piping and tank stands by use of anti-electrolytic and galvanic isolators.

3.16 DRAIN LINES

A. Provide condensate drain lines from each cooling coil and evaporative media sump drain pan to drain or to termination indicated. Drain lines to be galvanized pipe or Type M hard copper.

3.17 HEATING SYSTEM USED FOR TEMPORARY HEAT DURING CONSTRUCTION

A. Permanent heating system shall not be used until building is totally and permanently enclosed (no temporary barriers for weather protection), and source of heat supply is permanently installed.

B. Once the heating system has been placed into operation, it shall not be shut down except for moderate weather, and all heated areas shall be maintained at a minimum temperature of 50 deg. F 24 hours a day.

C. When any air-handling equipment is used for temporary heat, the filters (MERV 13) shall be installed and maintained. Before building acceptance by Owner, these units shall be thoroughly cleaned by HEPA vacuum and new filters shall be installed. This is over and above the extra set of filters to be provided the Owner as called for in the specifications. Coils shall be cleaned if necessary, as determined by the Engineer. If project is LEED provide additional MERV 8 filter overall return grilles to prevent debris from entering. Tape around perimeter edge to seal to grille.

D. Any and all systems being used for temporary heat shall become the Contractor's responsibility to maintain, and be put into first class working order before acceptance by the Owner.

E. Any manufacturer's guarantees that start with the use of equipment for temporary heat shall be extended by the contracting firm holding the prime contract for construction, so that the Owner will have his one-year guarantee from date of acceptance.

3.18 ELEVATOR SHAFT SMOKE VENT

A. Contractor shall test for operation to insure that vent is in working order.

B. Installation shall be in accordance with manufacturer's instructions.

END OF SECTION 230529

SECTION 230540 - MECHANICAL SOUND AND VIBRATION CONTROL

PART 1 - GENERAL

1.1 RELATED WORK

A. Requirements: Provide Mechanical Sound and Vibration Control in accordance with the Contract Documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 232113 - HVAC Piping & Specialties
Section 233300 - Ductwork and Accessories - Flexible Ductwork Connections

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

1. Support isolation for motor/driven mechanical equipment.
2. Rails or beams for distribution of equipment loading to isolation units.
3. Fabricated bases for distribution of equipment loading to isolation units.
4. Inertia base frames in conjunction with equipment isolation.
5. Isolation of pipes and ductwork.
6. Sound attenuating units.
7. Sound-linings.
8. Sound proofing of construction.
9. External sound proofing.

1.3 QUALITY ASSURANCE

A. The Division 23 Contractor shall be responsible for assuring that all the following sound pressure level criteria are met. Sound pressure level tests shall be carried out by the Section 230593 Contractor in compliance with the Section 230593 specifications.

B. Acoustical Criteria:

1. Noise levels due to equipment and ductwork to permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC curves:

All occupied spaces ---------- RC-35

except

Occupied spaces within 15 foot radius from mechanical rooms, main supply and return duct shafts ---------- RC-40

Lobbies, Toilets, Commons Area ---------- RC-40

Office ---------- NC-30

Vending Room ---------- NC-30

Mechanical Rooms ---------- RC-60-80

Telecommunications Room (24-hour cooling req'd)---- NC-30

C. Mechanical Acoustical Performance:

1. Air Distribution system equipment terminal device noise:

a. Maximum permissible discharge sound-power levels in octave bands of airborne transmission through the terminal units or related pressure reducing devices, when operated in installed condition per Drawings and Specifications shall be as per Table 1, following:

TABLE 1 - Maximum PWL (dB re 10E-12 Watt)				
Octave Band	RC-30	RC-35	RC-40	RC-45
1	54	59	64	69
2	68	73	78	83
3	61	66	71	76
4	59	64	69	74
5	51	56	61	66
6	48	53	58	63
7	39	44	49	54

2. Pressure reducing variable air volume boxes radiated noise:

a. Maximum permissible radiated sound-power levels in octave bands when operated in an installed condition over occupied spaces, shall be as per Table 2 following:

TABLE 2 - Maximum PWL (dB re 10E-12 Watt)				
Octave Band	RC-30	RC-35	RC-40	RC-45
1	54	59	64	69
2	62	67	72	77
3	58	63	68	73
4	55	60	65	70
5	53	58	63	68
6	50	55	60	65
7	46	51	56	61

3. Motor Acoustical Performance:

a. Motor drives for pumps when installed per Drawings and Specifications shall operate with noise levels not exceeding 90dbA.

b. Noise levels shall be determined in accordance with IEEE Standard #85 Test "Procedure for Air-Borne Noise Measurements on Rotating Electric Equipment.

4. Refrigeration Machine Cooler, Condenser, Compressor and Compressor Piping Acoustical Performance:

a. The maximum permissible noise levels under design operating conditions, when measured in accordance with the methods and qualifications specified herein shall not exceed 90 dbA.

1.4 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract.

1. Each type of isolator including spring diameters, deflections, compressed spring height and solid spring height.
2. Sound Attenuators.
3. Sound Lining.
4. Inertia Bases.

B. Test Reports: Submit certified test reports showing compliance in accordance with General Conditions of the Contract of the following items:

1. Pressure drop and insertion loss ratings for sound attenuators.
2. Certification that sound lining meets erosion test method described in UL Publication No. 181.

PART 2 - PRODUCTS

2.1 PIPING AND EQUIPMENT ISOLATION

A. Manufacturer: Mason Industries, Inc., Vibro-Acoustics.

B. Other acceptable manufacturers offering equivalent products: Korfund, Amber/Booth Co., Vibration Mountings and Control Co., Kinetics.

C. Neoprene Mounting Pads (Specification Schedule Type 1)

1. Kinetics Noise Control Type NPD.
2. Minimum static deflection 0.04” for 0.22” thick pad.
3. Cross, double ribbed elastomer in-shear pads, capable of 60 or 120 PSI loading, depending on load density of equipment being isolated.
4. Material thickness as required to provide minimum deflections listed in table at end of the specification section.

D. Double Deflection Neoprene Mountings (Specification Schedule Type 2)

1. Mason Industries Type ND Mounting, Type DNR Rails.
2. Minimum static deflection 0.35 inch.
3. Bolt holes where required.
4. Steel rails above mountings to compensate for overhang where required.

E. Spring Isolator Mountings (Specification Schedule Type 3)

1. Mason Industries Type SLF.
2. Free-standing, laterally stable without housing, complete with 1/4 inch neoprene acoustical friction pads between base plate and support and with leveling bolts that must be rigidly bolted to equipment.
3. Spring diameters no less than 0.8 of the compressed height of the spring at rated load.
4. Springs with minimum additional travel to solid equal to 50 percent rated deflection.

F. Restrained Spring Isolator Mountings (Specification Schedule Type 4)

1. Mason Industries Type SLR.
2. Spring isolator mounting equal to Type SLF but with housing that includes vertical resilient limit stops to prevent spring extension when weight is removed from equipment.
3. Provide hot dipped galvanized mountings exposed to weather.

G. Vibration Hangers (Specification Schedule Type 6)

1. Mason Industries Type DNH.
2. Spring and double deflection neoprene element in series.
3. Neoprene element minimum deflection 0.35 inch.
4. Spring diameters no less than 0.8 of compressed height of spring at rated load.
5. Springs with minimum additional travel to solid equal to 50 percent rated deflection.

H. Integral Structural Steel Base (Specification Schedule Type B)

1. Mason Industries Type WF.
2. Rectangular for equipment other than "T" or "L" shaped pump bases.
3. Pump bases for split case pumps to include supports for suction and discharge base ells.
4. Beams for perimeter members minimum depth equal to one tenth of the longest dimension of the base. Depth need not exceed 14 inches if deflection and misalignment is kept within acceptable limits by manufacturer.
5. Provide height saving brackets to provide a clearance of one inch.

I. Steel Rail Base (Specification Schedule Type B)

1. Mason Industries Type ICS.
2. Steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base.
3. Provide members sufficiently rigid to prevent strains in the equipment.

J. Concrete Inertia Bases (Specification Schedule C)

1. Mason Industries Type K.
2. Rectangular structural beam or channel concrete forms for floating foundations.
3. Provide bases for split case pumps large enough for suction and discharge base ells supports.
4. In general, unless shown otherwise on the Drawings, provide bases with a minimum depth of one twelfth of the longest dimension of the base, but not less than 6 inches.
5. Forms to include minimum concrete reinforcement consisting of 1/2 inch bars or angles welded in place on 6 inch centers running both ways in a layer 1-1/2 inches above the bottom, or additional steel as is required by the structural conditions.
6. Forms furnished with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts.
7. Provide height saving brackets to maintain a 1 inch clearance below base.

K. Flexible Butyl Hose Pipe Connectors (Up to 2")

1. Mason Industries Type RMM.
2. Flexible Butyl 150 lb. hose with brass screw type ends attached by expansion or swedging methods. Clamps are unacceptable.
3. Duty up to: 100 psi and 220 deg. F.
4. Hoses up to 1-1/4 inches shall be 12 inches in length and 1-1/2 inches to 2 inches shall be 18 inches in length.

L. Flexible Neoprene Sphere Pipe Connectors (2" to 12")

1. Mason Industries Type MFNC and Type MFTNC.
2. Neoprene single-sphere type with 150 lb. ASA steel floating flanges.
3. Duty up to: 150 psi and 230 deg. F.
4. Movement limits: minimal 3/8 inch axial compression, 1/4 inch axial elongation, 3/8 inch lateral movement and 15 deg. angular movement.

M. Braided Flexible Connectors (Drawing Code "FC")

1. Manufacturer: Thermo Tech, Inc., Metraflex, Flex-Hose Co., Flexicraft Industries, Flex-Precision ltd., Twin City Hose.
2. Flexible connectors manufactured of 300 series stainless steel convoluted metal bellows and braid, 150 psig ASA drilled flanges. Maximum permanent offset from centerline = ¾". Maximum intermittent offset from centerline = 3/8".
3. Pressure test to be certified for 300 psi at 250 deg. F.
4. Schedule:

Make: Metraflex									
Model: SLP									
Size:	1-1/2"	2"	2-1/2"	3"	4"	6"	8"	10"	12"
Connector Length:	6"	6"	10-1/4"	10-5/8"	11-3/4"	14-1/8"	15-3/8"	12-3/4"	18-3/8"
Max Pressure: 300 psig									
Max Temperature: 250 deg. F									

N. Acoustical Pipe Riser Anchors:

1. Mason Industries Type ADA.
2. All directional acoustical pipe anchor.
3. Minimum 1/2 inch thickness of heavy duty neoprene and duck isolation material.
4. Vertical restraints in either direction.

2.2 SOUND ATTENUATORS

A. Acceptable Manufacturers: SEMCO Manufacturing, Industrial Acoustics Company, Acoustifoil Noise Control Products, Koppers, Rink, Commercial Acoustics, Vibro-Acoustics, Price.

B. Factory prefabricated.

C. Shell:

1. Galvanized Steel: 22 ga. minimum.
2. Leakproof at pressure differential of 8 in. w.g.

D. Media:

1. Flamespread: Maximum 25.
2. Fuel contributed and smoke developed: Maximum 50.
3. Maximum 4.5 lbs. per cubic foot density glass or mineral fiber packed under 5 percent compression.
4. Filler to be inert, vermin and moisture proof.
5. Non-erosive and non-pregnable.

E. Internal Construction:

1. Galvanized perforated steel baffles: Minimum 24 gauge.
2. Cleanable construction.

F. Net Insertion Ratings:

1. Determined by duct-to-reverberant room test method at design airflow shall be as per Table 3 following:

TABLE 3			
		Sound Trap Dynamic Insertion Loss(db)	
Band No.	Band Center Freq. (HZ)	5 Feet	3 Feet
1	63	6	4
2	125	10	7
3	250	18	12
4	500	30	19
5	1000	42	23
6	2000	34	23

G. Maximum self-generated noise at 2000 ft. per minute face velocity shall be as per Table 4 following:

TABLE 4 - Sound Trap Self-Noise Level		
Band No.	Band Center Freq. (HZ)	Sound Trap Self-Noise (db re 10E-12W) 5 ft. & 3 ft.
1	63	63
2	125	54
3	250	52
4	500	50
5	1000	47
6	2000	48

2.3 SOUND LININGS

A. Acceptable Manufacturer: Johns Manville Permacote, Linacoustic and Spiracoustic.

B. Other acceptable manufacturers offering equivalent products: Knauf, CertainTeed ToughGuard R.

C. Product: Fibrous glass, acrylic surface coating, stenciled NFPA, conforming to ASTM C1071, ASTM G21 and ASTM G22.

D. Minimum thickness: As indicated in Part 3 of this specification.

E. Sound Absorption Coefficient for 1" thickness per the following:

Frequency (cps)	=	125	250	500	1000	2000	4000	NRC
Coefficient	=	0.09	0.29	0.65	0.78	0.83	0.80	0.70

F. Flamespread: Maximum 25.

G. Fuel contributed and smoke developed: Maximum 50.

H. Suitable for duct velocity of 5000 fpm. Lining shall meet erosion test method described in UL Publication No. 181.

I. Dynamic loss coefficient: Maximum 1.2.

J. Thermal conductivity 0.25 Btu/hr/deg F/in. @ 75°F mean temperature.

K. Provide additional facing for protection of acoustical liner at plenum fan discharge plenum in field-built, single wall fan plenums and where shown on drawings. Liner shall be 26 gauge steel with perforated 28% minimum open area.

2.4 ADHESIVE AND SEALER

A. Acceptable Products: Adhesive, Benjamin Foster "81-99", or accepted equal, Sealer, Benjamin Foster "82-07" or accepted equal.

B. In conformance with NFPA 90A.

C. Flamespread: Maximum 25.

D. Fuel contributed and smoke developed: Maximum 50.

2.5 NON-HARDENING CAULKING

A. Acceptable Products: Tremco "Polybutene", Schuller or accepted equal.

B. Guaranteed to be permanently elastic.

2.6 VIBRATION DAMPERING COMPOUND

A. Acceptable Manufacturers: Soundcoat GP-1 Vibration Damping Compound, Korfund Dynamics Corporation Vibro-damp 80A, Kinetics, Vibro-Acoustics.

B. Non-burning.

C. Compound shall effectively damp vibrations for a broad frequency range between 10 Hz to 20 kHz.

D. Decay rate Geiger plate 45 dB/sec. at 72 deg. F.

2.7 EXTERNAL SOUND BARRIER INSULATION

A. Acceptable Manufacturers: Kinetics Noise Control, Vibro-Acoustics.

B. Model: KNM 100 ALQ-1.

C. Sound barrier shall be a barrier/decoupling layer composite consisting of 1.0 lb. per ft^2 mass barrier bonded to 1" fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together to encapsulate the glass fibers. Provide with barrier tape for sealing joints.

D. Sound Transmission Loss:

1, Transmission loss when attached to outside of piping shall be as per the following table:

Band No.	Band Center Freq. (Hz)	Transmission Loss (dB)
1	125	13
2	250	16
3	500	24
4	1000	33
5	2000	43
6	4000	49
-	STC	28

E. Flamespread: Maximum 25.

F. Fuel contributed and smoke developed: Maximum 50.

2.8 EXTERNAL SOUND BARRIER INSULATION (PIPING)

A. Acceptable Manufacturers: Kinetics Noise Control, Vibro-Acoustics.

B. Model: KNM 100 ALQ-1.

C. Sound barrier shall be a barrier/decoupling layer composite consisting of 1.0 lb. per ft^2 mass barrier bonded to 1" fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together to encapsulate the glass fibers. Provide with barrier tape for sealing joints.

D. Sound Transmission Loss:

1. Transmission loss when attached to outside of piping shall be as per the following table:

Band No.	Band Center Freq. (Hz)	Transmission Loss (dB)
1	125	13
2	250	16
3	500	24
4	1000	33
5	2000	43
6	4000	49
-	STC	28

E. Flamespread: Maximum 25.

F. Fuel contributed and smoke developed: Maximum 50.

2.9 EXTERNAL SOUND BARRIER INSULATION (SHEET METAL)

A. Acceptable Manufacturers: Kinetics Noise Control, Vibro-Acoustics.

B. Model: KNM 100 ALQ-1.

C. Sound barrier shall be a barrier/decoupling layer composite consisting of 1.0 lb. per ft^2 mass barrier bonded to 1" fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together to encapsulate the glass fibers. Provide with barrier tape for sealing joints.

D. Sound Transmission Loss:

1. Transmission loss when attached to outside of piping shall be as per the following table:

Band No.	Band Center Freq. (Hz)	Transmission Loss (dB)
1	125	13
2	250	16
3	500	24
4	1000	33
5	2000	43
6	4000	49
-	STC	28

E. Flamespread: Maximum 25.

F. Fuel contributed and smoke developed: Maximum 50.

PART 3 - EXECUTION

3.1 GENERAL - PIPING AND EQUIPMENT ISOLATION

A. Unless otherwise noted on the Equipment Mounting Schedule, provide mechanical equipment mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators to be selected in accordance with the weight distribution so as to produce reasonable uniform deflection. Deflections to be as noted on the Equipment Mounting Schedule included at the end of this section.

B. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following the isolation work, to avoid any contact which would reduce the vibration isolation.

C. The installation or use of vibration isolators must not cause any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, maintain equipment and piping in a rigid position during installation. Do not transfer the load to the isolator until the installation is complete and under full operational load.

D. Support the machine to be isolated with a structural steel frame.

E. Provide brackets to accommodate the isolator and provide a mechanical stop. The vertical position and size of the bracket to be recommended by the isolator manufacturer.

F. For restrained spring isolators, use housing as blocking during erection so that installed and operating heights can be the same. Maintain a minimum clearance of 1/2 inch around restraining bolts between housing and spring to avoid interference with spring action. Limit stops to be out of contact during normal operation.

3.2 HANGERS

A. Install type 2 or 3 vibration isolation piping hangers where indicated in Equipment Mounting Schedule at the end of this section and within 20 feet (measured along piping) upstream and downstream of all pumps 3 HP or larger.

B. Install the isolators with the isolator hanger box attached to or hung as close as possible to the structure.

C. Suspend the isolators from substantial structural members, not from slab diaphragm unless specifically accepted.

D. Align hanger rods to clear hanger box.

3.3 EQUIPMENT BASES

A. Provide minimum operating clearance between the equipment frame or rigid steel base frame and the housekeeping pad or floor of 1 inch. Provide minimum operating clearance between concrete inertia base and the housekeeping pad or floor of 1 inch.

3.4 COIL BASES

A. Mount floor supported coil section on a 1/4" thick layer of ribbed neoprene pad, with a 16 gauge galvanized steel plate between coil frame and pad. Coil shall be mounted on a concrete curb of sufficient height to allow coil drain pan to be sloped in two directions to drain pan bottom outlet with P-trap and/or refrigerant suction line traps to be installed without hitting floor.

3.5 FLEXIBLE PIPING CONNECTORS

A. Provide flexible connectors for equipment that is supported by or mounted on vibration isolators except when connected piping is made up with a Victaulic Flex coupling system. Connectors to be installed under Section 232113.

B. Hoses shall be installed on the equipment side of the shut-off valves and horizontally wherever possible.

C. Provide connectors at pump suction and discharge, and elsewhere as required to accommodate thermal expansion, vibration and misalignment.

D. Provide flexible connectors on all suction and discharge connections to all base mounted centrifugal pumps, vertical turbine pumps, air compressors, dryers, vacuum pumps or other equipment items producing vibration, shock, noise, or thermal motion of piping.

E. Provide 300 psi companion flanges for connector for threaded, welded, soldered, or brazed piping as appropriate.

F. Connectors to be aligned, centered, and shall not bear weight of pipe, fittings, or pipeline accessories such as valves. Piping shall be supported both sides of horizontal or vertical connectors.

3.6 PIPE FLOOR SUPPORTS

A. Provide type 3 mountings with a minimum static deflection of 1.5 inches on horizontal pipe floor supported at slab in equipment rooms above grade.

3.7 SOUND ATTENUATORS

A. Install in accordance with manufacturers' recommendations to obtain published performance.

B. After installation, measure total system pressure before and after attenuators.

C. If pressure loss exceeds maximum static pressure loss schedules on drawings: modify entrance or discharge aerodynamic flow to obtain specified performance.

D. For maximum structural integrity, sound attenuator baffles should be installed in a vertical position; where this is not possible, structural reinforcement is required for attenuators wider than 24 in.

E. When elbows precede attenuators, baffles shall be parallel to the plane of the elbow radius.

3.8 SOUND LININGS

A. Dimensions of lined ductwork are clear inside dimensions after lining has been installed.

B. Sound linings to be held in place with mechanical fasteners as per the latest SMACNA duct liner application standard, with joints and any tears to be coated with Benjamin Foster or accepted equal adhesive. The transverse joints to be coated prior to installation so that the ends of the liner are compressed together while the adhesive is still moist, forming a seal of the leading and trailing edge of each joint. Excess adhesive to be brushed to an even finish over the joint.

C. Provide continuous sheet metal edge protectors at entering and leaving edges of lined duct sections where adjacent to unlined duct sections.

D. Extent of 1” ductwork sound linings:

1. Upstream of toilet/general exhaust fans and relief air fans, a minimum distance of 20'-0".
2. Downstream of VAV boxes.
3. Transfer air ducts and shaft return stub ducts.
4. In low pressure supply, return and rectangular exhaust ducting.
5. Return air elbow boots over ceiling grilles.
6. In plenums above supply diffusers.
7. Elsewhere when specifically indicated on drawings.
8. Do not install liner in duct serving evaporative cooled systems 10’-0” downstream of media.

E. Extent of plenum sound linings:

1. Mixed and outside air plenum walls and ceilings.
2. Supply air discharge and filter plenum walls and ceiling.
3. Return/Exhaust air plenums.
4. Return air plenum from riser to mixed air plenum.
5. Return/Exhaust air plenums inside packaged rooftop units when not factory installed.

3.9 SOUND PROOFING OF CONSTRUCTION

A. Required for opening between ductwork and piping and following construction:

1. Equipment room walls.
2. Floors, except in shafts.
3. Roofs, specifically inside roof curbs for mechanical equipment and where ductwork penetrates roof deck.

B. Sound proofing:

1. Fill openings with tightly packed fibrous glass blanket or board for full depth of penetration.
2. Caulk each side of opening with non-hardening, non-aging caulking compound.

3.10 EXTERNAL VIBRATION DAMPENING

A. For typical floor supply duct take-offs from main supply riser when required to meet specified sound levels, provide 1/8 inch thick duct exterior coating of vibration dampening compound. These treatments to be provided over the rectangular portion (flat sides) of the floor take-off ducts.

3.11 EXTERNAL SOUND BARRIER INSULATION

A. Provide foam composite, applied over the vane axial fan casings (both supply and return) extending from the inlet side of the intake sound traps, to the leaving side of the discharge sound traps, inclusive of all flexible connectors.

B. Provide a duct enclosure of 2 layers of 5/8" gypsum board with staggered seams extending from the point that the ducts leave the rooftop unit or fan plenum to the leaving side of the discharge sound trap(s). A minimum clearance of 1" shall be maintained between the ductwork and the enclosure walls; all voids between the enclosure and the ductwork to be filled with loose batt fiberglass insulation. The points at which the ductwork penetrates the enclosure; the sheetrock is to be cut away from the ductwork by 1/4" to 1/2" and the void is to be filled with non-hardening caulk. Caulk shall be fire-rated if enclosure is required to be fire-rated.

3.12 EQUIPMENT MOUNTING SCHEDULE

A. Manufacturer: Mason Industries, Inc., Kinetics, Vibro-Acoustics.

B. Schedule: See the following pages.

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PUMPS						
A. Close Coupled						
1. Up to 7 1/2 HP	B/C	2	.25	C	3	.75
2. 10 HP & Over	C	3	.75	C	3	.75

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PUMPS						
A. Flexible Coupled						
1. Up to 40 HP	C	3	.75	C	3	.75
2. 50 to 125 HP	C	3	.75	C	3	.75
3. 150 HP & Over	(See Note 1)			(See Note 1)		
COOLING TOWERS, FLUID COOLERS & EVAPORATIVE CONDENSORS						
A. Up to 300 RPM	(See Note 2)			(See Note 2)		
B. 301 to 500 RPM	A	1,2	.25	A	4	2.5
C. 501 RPM & Over	A	1,2	.25	A	4	.75
FANS						
AXIAL & TUBULAR FAN HEADS						
A. Up to 22 in. dia.	A/B	2	2.5	A/B	3	.75
B. 24 in. dia. & Over						
1. Up to 50 HP						
a. Up to 300 RPM	(See Note 2)			(See Note 2)		
b. 301 to 500 RPM	B/C	3	1.5	C	3	1.5
C. 501 RPM & Over	B/C	3	.75	C	3	1.5
2. 60 HP & Over	(See Note 1)			(See Note 1)		

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
CENTRIFUGAL FANS & VENTILATION SETS						
A. Up to 22 in. Wheel dia.	A/B	2	.25	A/B	3	.75
B. 24 in. Wheel dia. & Over						
1. Up to 50 hp						
a. Up to 300 RPM	(See Note 2)			(See Note 2)		
b. 301 to 500 RPM	B	3	1.5	B	3	1.5
c. 501 RPM & Over	B	3	.75	B	3	.75
2. 60 HP & Over						
a. Up to 300 RPM	(See Note 2)			(See Note 2)		
b. 301 to 500 RPM	B/C	3	.75	C	3	1.5
c. 501 RPM & Over	B/C	3	.75	C	3	1.5
PACKAGED AIR HANDLING EQUIPMENT						
A. Up to 10 HP	A	2	.25	A	3	.75
B. 15 HP & Over	A	2	.25	A	3	.75

EQUIPMENT VIBRATION ISOLATION SCHEDULE

EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PACKAGED ROOFTOP AIR CONDITIONING UNIT	--	--	--	D	3	.75

BASE TYPES:

A = NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT
B = STRUCTURAL STEEL RAILS OR BASE
C = CONCRETE INERTIA BASE
D = CURB-MOUNTED BASE

ISOLATOR TYPES

1 = RUBBER OR GLASS FIBER PAD
2 = RUBBER FLOOR ISOLATOR OR HANGER
3 = SPRING FLOOR ISOLATOR OR HANGER
4 = RESTRAINED SPRING ISOLATOR
5 = SPRING AND RUBBER IN SERIES HANGER

NOTES:

1. CONTRACTOR SHALL PROVIDE VIBRATION ISOLATION AND CALCULATIONS STAMPED BY A LICENSED PROFESSIONAL ENGINEER.

2. TO AVOID ISOLATOR RESONANCE PROBLEMS, SELECT ISOLATOR DEFLECTION SO THAT NATURAL FREQUENCY IS 40% OR LESS THAN LOWEST OPERATING SPEED OF EQUIPMENT (SEE ASHRAE HVAC APPLICATIONS HANDBOOK, 1999 EDITION).

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	30 FT. FLOOR SPAN			40 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PUMPS						
A. Close Coupled						
1. Up to 7 1/2 HP	C	3	.75	C	3	.75
2. 10 HP & Over	C	3	1.5	C	3	1.5

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	30 FT. FLOOR SPAN			40 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PUMPS						
A. Flexible Coupled						
1. Up to 40 HP	C	3	1.5	C	3	1.5
2. 50 to 125 HP	C	3	1.5	C	3	2.5
3. 150 HP & Over	(See Note 1)			(See Note 1)		
COOLING TOWERS, FLUID COOLERS & EVAPORATIVE CONDENSORS						
A. Up to 300 RPM	(See Note 2)			(See Note 2)		
B. 301 to 500 RPM	A	4	2.5	A	4	2.5
C. 501 RPM & Over	A	1,2	1.5	A	4	1.5
FANS						
AXIAL & TUBULAR FAN HEADS						
A. Up to 22 in. dia.						
1. Up to 50 HP						
a. Up to 300 RPM	(See Note 2)			(See Note 2)		
b. 301 to 500 RPM	C	3	2.5	C	3	2.5
C. 501 RPM & Over	B/C	3	1.5	C	3	2.5
2. 60 HP & Over	(See Note 1)			(See Note 1)		

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	30 FT. FLOOR SPAN			40 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
CENTRIFUGAL FANS & VENTILATION SETS						
A. Up to 22 in. Wheel dia.	A/B	3	.75	A/C	3	.75
B. 24 in. Wheel dia. & Over						
1. Up to 50 hp						
a. Up to 300 RPM	(See Note 2)			(See Note 2)		
b. 301 to 500 RPM	B	3	1.5	B	3	2.5
c. 501 RPM & Over	B	3	.75	B	3	1.5
2. 60 HP & Over						
a. Up to 300 RPM	(See Note 2)			(See Note 2)		
b. 301 to 500 RPM	C	3	2.5	C	3	2.5
c. 501 RPM & Over	C	3	1.5	C	3	2.5
PACKAGED AIR HANDLING EQUIPMENT						
A. Up to 10 HP	A	3	.75	A	3	.75
B. 15 HP & Over	A	3	1.5	A	3	1.5

EQUIPMENT VIBRATION ISOLATION SCHEDULE

EQUIPMENT TYPE	30 FT. FLOOR SPAN			40 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PACKAGED ROOFTOP AIR CONDITIONING UNIT	A/B	3	1.5	A/B	3	2.5

BASE TYPES:

A = NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT
B = STRUCTURAL STEEL RAILS OR BASE
C = CONCRETE INERTIA BASE
D = CURB-MOUNTED BASE

ISOLATOR TYPES

1 = RUBBER OR GLASS FIBER PAD
2 = RUBBER FLOOR ISOLATOR OR HANGER
3 = SPRING FLOOR ISOLATOR OR HANGER
4 = RESTRAINED SPRING ISOLATOR
5 = SPRING AND RUBBER IN SERIES HANGER

NOTES:

1. CONTRACTOR SHALL PROVIDE VIBRATION ISOLATION AND CALCULATIONS STAMPED BY A LICENSED PROFESSIONAL ENGINEER.

2. TO AVOID ISOLATOR RESONANCE PROBLEMS, SELECT ISOLATOR DEFLECTION SO THAT NATURAL FREQUENCY IS 40% OR LESS THAN LOWEST OPERATING SPEED OF EQUIPMENT (SEE ASHRAE HVAC APPLICATIONS HANDBOOK, 1999 EDITION).

END OF SECTION 230540

SECTION 230548 - MECHANICAL SEISMIC CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Anchorage and seismic restraint systems for all Division 23 isolated and non-isolated equipment, ductwork and piping systems.

B. Equipment/piping/ductwork to be isolated and/or seismically supported shall include but not be limited to the following:

1. Piping
2. Ductwork
3. Sound Attenuators
4. Unit Heaters
5. Radiant Ceiling Panels
6. Boilers
7. Air Separators
8. Expansion Tanks
9. Condensers
10. Heat Pumps
11. Cooling Tower
12. Supply Air Fans
13. Hanging Exhaust Fans
14. Pumps
15. Glycol Tanks/Pumps
16. Chemical Treatment Stands
17. Water Storage Tanks
18. Heat Exchangers
19. Computer Room AC Equipment
20. Air Handling Units
21. Domestic Water Heaters
22. Solar Panels

1.2 RELATED WORK

A. Requirements: Provide Mechanical Seismic Control in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

D. Section 230540 - Mechanical Sound and Vibration Control.

1.3 REFERENCES

A. International Building Code, Current Edition in use by Jurisdictional Authority.

B. NFPA Bulletin 90A, Current Edition.

C. UL Standard 181.

D. Tri-Services Manual, Fagel Et Al, 1973.

E. SMACNA Seismic Restraint Manual: Guidelines for mechanical systems.

1.4 SYSTEM DESCRIPTION

A. The Division 23 Contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachments, supports, seismic snubbers and bracing to comply with the following:

1. Seismic Use Group II.
2. Short period design spectral response acceleration coefficient S_{DS}= 1.2.
2. One-second period design spectral response acceleration coefficient S_{D1}= 0.78.
3. Site Class D
4. Seismic Design Category E.

B. The following components have a component importance factor I_P of 1.5:

1. Fire Sprinkler Protection System.

All other components have an importance factor I_P of 1.0.

1.5 QUALITY ASSURANCE

A. All supports, hangers, bases, anchorage and bracing for all isolated equipment and non-isolated equipment shall be designed by a professional engineer licensed in the state where the project is located, employed by the restraint manufacturer, qualified with seismic experience in bracing for mechanical equipment. Shop drawings included with deferred submittal for earthquake bracing and anchors from the restraint manufacturer shall bear the Engineer's signed professional seal. All calculations/design work required for the seismic anchorage and restraint of all Division 23 equipment and systems shall be provided by a single firm.

B. The above qualified seismic engineer shall determine specific requirements for equipment anchorage and restraints, locations and sizes based on shop drawings for the mechanical equipment which have been submitted, reviewed and accepted by the Architect/Engineer for this project.

C. Seismic Engineer or the Engineer’s Representative shall field inspect final installation and certify that bracing and anchorage are in conformance with the Seismic Engineer’s design. A certificate of compliance bearing the Seismic Engineer’s signed Professional Engineer’s seal shall be submitted and shall be included in each copy of the Operation and Maintenance Manuals.

D. The Division 23 Contractor shall require all equipment suppliers to furnish equipment that meets the seismic code, with bases/skids/curbs designed to receive seismic bracing and/or anchorage. All isolated and non-isolated mechanical equipment bracing to be used in the project shall be designed from the Equipment Shop Drawings and certified correct by the equipment manufacturer for seismic description listed in Paragraph 1.4 above, with direct anchorage capability.

1.6 SUBMITTALS

A. A single submittal shall be provided for all seismic anchorage and restraints for all Division 23 equipment and systems provided as part of this project. Individual submittals for specific systems will not be accepted.

B. Submit shop drawings, calculations, and printed data for the following items under provisions of the General Conditions of the Contract:

1. Complete engineering calculations and shop drawings for all seismic requirements for all equipment to be restrained as outlined in Paragraph 1.1 above, and as detailed on drawings.
2. The professional seal of the engineer who is responsible for the design of the Seismic Restraint System.
3. Details for all seismic bracing.
4. Details for steel frames, concrete inertia bases, and housekeeping pads. Include dimensions, embed depths, dowelling details, and concrete reinforcing requirements.
5. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors, snubbers, cables, and bolt connections.
6. Floor plan noting the locations, size, and type of anchorage and restraint to be used.
7. Include confirmation that all calculations are based on the design criteria listed in Paragraph 1.4.A of this Section.
8. Certificate of Compliance.

PART 2 - PRODUCTS

2.1 RESTRAINT EQUIPMENT AND SYSTEMS

A. Acceptable Manufacturers and Suppliers for Non-Isolated Systems:

1. Mason Industries, Inc.
2. Korfund
3. Amber/Booth Company
4. Vibration Mountings and Control Company
5. Kinetics
6. International Seismic Application Technology
7. Tolco
8. Vibro-Acoustics

B. Manufacture and design of restraints and anchors for isolated equipment shall be by the manufacturer of the vibration isolators furnished for the equipment in accordance with Section 230540.

2.2 SNUBBERS

A. Snubbers shall be all-directional and consist of interlocking steel members restrained by replaceable shock absorbent elastomeric materials a minimum of 3/4 inch thick.

B. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch or more than 1/4 inch.

C. Snubbers shall be Mason Industries Z - 1011 or accepted equivalent.

PART 3 - EXECUTION

3.1 DESIGN AND INSTALLATION

A. General:

1. All mechanical equipment, piping and ductwork shall be braced, anchored, snubbed or supported to withstand seismic disturbances in accordance with the criteria of this specification. Provide all engineering, labor, materials and equipment for protection against seismic disturbances as specified herein. The following mechanical components are exempt from seismic restraint requirements:

   a. Components in Seismic Design Categories A and B (see 1.4-A-5 above).
   b. Components in Seismic Design Category C (see 1.4-A-5 above) that have an importance factor I_P of 1.0 (see 1.4-B above).
   c. Components that have an importance factor I_P of 1.0 (see 1.4-B above), that are mounted less than four feet above the floor, that weigh less than 400 pounds, and that have flexible ductwork, piping, and conduit connections.
   d. Components that have an importance factor I_P of 1.0 (see 1.4-B above), that weigh 20 pounds or less, and that have flexible ductwork, piping, and conduit connections.

2. Powder-actuated fasteners (shot pins) shall not be used for component anchorage in tension applications in Seismic Design Category D, E, or F.
3. Attachments and supports for mechanical equipment shall meet the following provisions:

   a. Attachments and supports transferring seismic loads shall be constructed of materials suitable for the application and designed and constructed in accordance with a nationally recognized structural code such as, when constructed of steel, AISC, Manual of Steel Construction (Ref. 9.8-1 or 9.8-2).
   b. Friction clips shall not be used for anchorage attachment.
   c. Expansion anchors shall not be used for mechanical equipment rated over 10 hp (7.45 kW). Exception: Undercut expansion anchors.
   d. Drilled and grouted-in-place anchors for tensile load applications shall use either expansive cement or expansive epoxy grout.
   e. Supports shall be specifically evaluated if weak-axis bending of light-gauge support steel is relied on for the seismic load path.
   f. Components mounted on vibration isolation systems shall have a bumper restraint or snubber in each horizontal direction. The design force shall be taken as $2F_p$. The intent is to prevent excessive movement and to avoid fracture of support springs and any non-ductile components of the isolators.
   g. Seismic supports shall be constructed so that support engagement is maintained.

B. Install ceiling mounted items in accordance with ASTM C 636.

1. Ceiling mounted air terminals or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.

2. Terminals or services weighing 20 pounds but not more than 56 pounds, in addition to the above, shall have two No. 12 gauge hangers connected from the terminal or service to the ceiling system hangers or to the structure above. These wires may be slack.
3. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.

C. Spring Isolated Equipment:

1. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases as described in the vibration control specifications unless the equipment manufacturer certified direct attachment capability. Each spring mounted base shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. Snubbers shall be installed with factory set clearances.

D. Non-Isolated Equipment:

1. The Division 230548 Contractor shall be responsible for thoroughly reviewing all drawings and specifications to determine all equipment to be restrained. This Contractor shall be responsible for certifying that this equipment is mounted and braced such that it adheres to the system description criteria in part 1.04 of this specification section.

E. Piping:

1. Seismic braces for piping may be omitted when the distance from the top of the pipe to the supporting structure is 12" or less.
2. A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
3. Unbraced piping attached to in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.
4. At the interface of adjacent structures or portions of the same structure that may move independently, utility lines shall be provided with adequate flexibility to accommodate the anticipated differential movement between the ground and the structure.
5. Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.

F. Ductwork:

1. Seismic restraints are not required for HVAC ducts with importance factor I_P of 1.0, provided that either of the following conditions are met for the full length of each duct run:

   a. HVAC ducts are suspended from rod hangers and hangers are 12 inches or less in length from the point rod attaches to duct, to the point rod connects to the supporting structure. Rods must be secured to both top and bottom cross angles with locking nuts above and below angle iron.
   b. HVAC ducts have a cross-sectional area of less than 6 square feet.
   c. This exception is not valid if the top of ductwork is not secured to hanger rods to limit pendulum length to 12 inches.

2. Equipment items installed in-line with the duct systems with an operating weight greater than 75 pounds shall be supported and laterally braced independently of the duct system.

END OF SECTION 230548

SECTION 230593 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these Documents.

B. TAB will be responsible to carry out the commissioning requirements specified in other sections.

C. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230593 - Ductwork and Accessories

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

1. Upon completion of the installation of all the plumbing, air and heating or cooling water systems and solar heating systems, all necessary adjustments shall be made to provide capacities listed on the Drawings to properly balance these systems.
2. Submittals and written reports as specified.
3. Testing requirements as described in Specification Section 230500, paragraph 1.16.
4. Witness duct leakage test required by Specification Section 230500 – Ductwork and Accessories.
5. Provide assistance, in cooperation with the various trades, in the final adjustments and test of the Life Safety Systems to comply with the requirements of the local Building and Fire Departments.
6. Provide Owner training as described in Specification Section 230500.
7. Contract to be carried by General Contractor.

1.3 QUALITY ASSURANCE

A. Work under this section shall be executed under the direct supervision of a Registered Professional Engineer having an established professional office in the State of Utah and having an experience record of not less than five (5) years in the mechanical contracting industry, engaged in testing, balancing and adjusting of air and hydronic mechanical systems for not less than two (2) years of that time, or, under the direct supervision of a qualified testing, adjusting and balancing supervisor, possessing certification from the National Environmental Balancing Bureau (NEBB) or from the Associated Air Balance Council (AABC).

B. Comply with the applicable procedures in the chapter on Testing, Adjusting and Balancing in the latest ASHRAE Edition of the NEBB, AABC, and SMACNA Test and Balance documents.

C. Calibration and maintenance of instruments shall be in accordance with manufacturer's standards and recommendations, and calibration histories for each instrument shall be available for examination.

D. Accuracy of measurements shall be in accordance with the applicable measurement means as listed in the latest edition of NEBB, AABC, and SMACNA Test and Balance documents.

E. Allowable Tolerances:

1. Tolerances of adjustment for air handling systems are plus or minus 5% for supply systems at air devices and plus or minus 10% for return and exhaust systems from figures shown on drawings.
2. Tolerances of adjustment for hydronic systems, are plus or minus 10% of design conditions shown on drawings.

F. Final Testing, Adjusting and Balancing of all hydronic and air systems shall be performed by an approved separate professional (working under the General Contractor) Testing, Adjusting and Balancing subcontractor meeting the above Quality Assurance requirements (working under the General Contractor). Acceptable separate professional subcontractors meeting the above requirements are as follows:

1. BTC Services, Inc.
2. Certified Testing & Balancing, Inc.
3. Bonneville Test & Balance
4. RS Analysis, Inc.
5. Danis Test & Balance, Inc.
6. Independent Test & Balance, LLC

G. Subcontractors not listed above must submit for acceptance.

H. The Contractor will provide the services of a qualified test and balance contractor. The qualifications of the TAB contracting firm shall be submitted, along with the specific qualifications of the lead site technician who will remain on site during all TAB work, within 10 days of notice to proceed. Recent projects shall be listed and described for both the company and the lead technician. Names and telephone numbers of the project contractors and facility managers will be provided.

I. The owner must approve in writing the qualification of both the company and the lead technician.

J. Within 30 days after execution of the Owner-Contractor Agreement, transmit to Architect/Engineer the name of the organization proposed to perform the services.

1.4 SUBMITTALS

A. Procedure: Submit Qualifications, Documentation, Test Schedules and Reports in accordance with the General Conditions of the Contract:

B. Qualifications:

1. Submit three copies of documentation to confirm compliance with Quality Assurance provisions:

   a. Organization supervisor and personnel training and qualifications.
   b. Specimen copy of each of the report forms proposed for use.

C. Preliminary Report: At least fifteen days prior to starting field work, submit three copies of:

1. A set of report forms filled out as to the design flow values and the installed equipment pressure drops, and the required CFM for air terminals.

2. A complete list of instruments proposed to be used, organized in appropriate categories, with data-sheets for each. Show:

   a. Manufacturer and model number.
   b. Description and use when needed to further identify the instrument.
   c. Size of capacity range.
   d. Latest calibration date.

3. Architect/Engineer will review submittals for compliance with Contract Documents, and will return one set marked to indicate:

   a. Discrepancies noted between measured data and Contract Documents.
   b. Additional, or more accurate, instruments required.
   c. Requests for re-calibration of specific instruments.

D. Schedules:

1. Schedule tests to comply with project completion schedules.
2. Schedule testing and balancing of parts of the systems which are delayed due to seasonal, climatic, occupancy, or other conditions beyond control of the Contractor, as early as the proper conditions will allow, after consultation with Architect/Engineer.
3. Submit reports of delayed testing promptly after execution of those services.

E. Final Report: At least fifteen days prior to Contractor's request for final inspection, submit three copies of final reports, on applicable reporting forms, for review. Submit a fourth copy directly to the Engineer. Each individual final reporting form must bear the signature of the person who recorded data and that of the NEBB or AABC certified supervisor of the reporting organization. Identify instruments of all types which were used and last date of calibration of each. Report shall include:

1. A detailed letter to Engineer outlining all abnormal or notable conditions not covered in above data specifically identifying all locations where specified flow tolerances could not be met.
2. A set of reduced black and white or blueline prints with all air openings clearly marked to correspond with data sheets and with thermometer locations clearly marked.
3. Data sheets showing amount of air handled at each opening, instrument used, velocity readings, and manufacturer free area factor.

4. Data sheets giving log of room temperatures in rooms exhibiting objectionable temperatures during the heating season. Logs shall be taken when outside temperature is 30 deg.F or colder.
5. Data sheets giving log of room temperatures in rooms exhibiting objectionable temperatures during the cooling season. Logs shall be taken with full occupant load, full lighting, and maximum solar conditions.
6. Equipment data sheets giving make, size and model, of fans, starters and motors with rated amps and service factors, and drives. Include pumps, supply fans, exhaust and recirculating fans.
7. Operating data including fan RPM, inlet and outlet pressures, pressure drop across filters, face and bypass dampers, and measured motor current and voltage, BHP and CFM (total).
8. Heating equipment operating data including air temperatures entering and leaving heating coils (maximum air temperature rise), together with corresponding air flow and air pressure drop, water temperature entering and leaving heating coil, water flow and pressure drop through heating coil.
9. Cooling equipment operating data including air temperatures entering and leaving cooling coils together with corresponding air flow and air pressure drop, water temperature entering and leaving cooling coil, and water flow and pressure drop through cooling coil.
10. Cooling tower operating data including measurements of hot water, cold water and wet-bulb temperatures, circulating water flow rate, fan RPM, fan power and wind velocity.
11. Prime cooling equipment operating data including condenser and evaporator flow rate, entering and leaving water temperatures and corresponding chiller load percentage. Pressure drop through condenser evaporator.
12. Equipment and operating data as required to show performance of pumps, heat exchangers, domestic hot water circulating systems, heating, ventilating, and air conditioning units, cabinet heaters, unit heaters, unit ventilators, fans and temperature control devices.
13. Sound pressure levels showing readings in all 8 octave bands and plotted on RC(II) charts shall be submitted for the following:

    a. All sides of Mechanical Rooms.
    b. Lobbies, Toilets, and Commercial Area.
    c. Conference Rooms.
    d. Spaces within 20 ft. of parking garage ventilation fan inlets and outlets.
    e. All spaces exhibiting abnormally high or annoying noise levels.

14. Domestic hot water recirculation data including flow at each branch shown requiring specific flow, and at the pump.

1.5 PROJECT CONDITIONS

A. The following job conditions must be verified before any testing, adjusting or balancing of the environmental systems begin:

1. Installation of the designated system is complete and in full operation.
2. On hydronic systems, strainers shall be cleaned, temperature control valve operation shall be checked, pump rotation shall be checked, pressure reducing valves shall be adjusted, and other such conditions requiring correction.
3. Air systems shall be checked for dirty filters, filter leakage, equipment vibrations, damper operation, fan rotation, and other such conditions requiring correction.

PART 2 - PRODUCTS

- NOT USED –

PART 3 - EXECUTION

3.1 PROCEDURE

A. Confirm that project conditions have been verified and that necessary corrections have been made before proceeding with the Work.

B. The Test and Balance Contractor must proportion air/water flows in the system while introducing a minimum amount of resistance. All systems are to be proportionally balanced.

C. Hydronic Systems:

1. Using system flow meters and/or contact pyrometer, the balancing firm shall adjust the quantity of water or glycol solution handled by each pump and supplied to each coil, solar collector, heat exchanger, cooling tower, and such other primary source equipment to meet design requirements, and mark each balancing cock at final setting.

D. Air Systems:

1. The balancing firm shall adjust all dampers, diffusers, registers, belts and sheaves for the delivery and distribution of air quantities shown in the Contract Documents and shall mark each balancing device at final setting.
2. Adjust fan speeds and motor drives within drive limitations for required air volume, provide new sheaves as necessary or adjustable bands on constant volume plenum fans, and notify Division 26 Contractor of any thermal overloads that need to be changed/replaced.
3. Measure static air pressure conditions on air supply units, including individual filter and coil pressure drops, and total pressure across the fan. Make allowances for 0.5” w.c., equivalent to 50% loading of filters.
4. Exhaust and recirculation air systems shall be adjusted for air quantities shown on Drawings.
5. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
6. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
7. Measure building static pressure in both economizer mode and minimum outside air mode, and adjust supply, return and exhaust air systems to provide the required relationship between each to maintain approximately 0.05 inches water column positive static pressure at the Building Entries.
8. Distribution system shall be adjusted to obtain uniform space temperatures free from objectionable drafts and noise.
9. Where multiple air diffusers are shown on one terminal box, adjust dampers for the delivery and distribution of air quantities shown in the Contract Documents.
10. Set all VAV boxes at minimum/maximum air flow shown on drawings.
11. Adjust air flow switches for proper operation on all fan powered VAV boxes.

12. Report: After all adjustments are made, a detailed report shall be prepared by the balancing firm and submitted to the Architect for approval. Owner reserves the right to spot check the report prior to final acceptance.

E. Plumbing System:

1. Hot Water Recirculation Systems: Set flow at each balancing valve shown. Record flow at each pump. Verify the proper installation of automatic flow control valves.

END OF SECTION 230593

SECTION 230700 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED WORK

A. Requirements: Provide insulation in accordance with the Contract Documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 224450 - Plumbing Equipment
Section 232113 - HVAC Piping & Specialties
Section 235200 - Boilers
Section 236400 - Refrigeration
Section 235700 - Heat Transfer
Section 233100 - Air Distribution

1.2 SYSTEM DESCRIPTION

A. The mechanical insulation work required by this Section shall include materials and methods as described herein and on the Drawings and as required by applicable energy codes.

B. The work includes, but is not limited to providing insulation on the following:

1. Plumbing Systems:

Domestic Hot Water-Supply, Recirculating, Hot Water Converters, and Storage Tanks
Tempered Domestic Water-Supply, Recirculating and Storage Tanks
Tempered Domestic Water Circulating
Domestic Cold Water
Primary Roof Drain System
Overflow Roof Drain Bowls
Chilled Drinking Water Piping, Recirculating and Storage Tanks

2. Heating Systems:

Heating Water Supply and Return
Heat Exchangers, Converters and Air Separators
Thermal Storage Tanks
Boiler Feed Water
Blowdown Separator Tank & Vent
Blowdown Discharge Piping
Flue Gas Breeching and Single Wall Stacks
Stacks to Roof
Boiler Drum Heads

3. Chilling Systems:

   Air Separators
   Condenser Water
   Heat Pump Water
   Thermal Storage Tanks and Chilled Water Storage Tanks

4. Refrigerant Systems:

   Refrigerant Piping
   Condenser Water
   Cold Condensate Drains

5. Air Distribution Systems:

   Exterior surfaces of all plenums and ducts which are a part of the following systems where duct or plenum is not lined (see Section 230540):
   Outside Air
   Combustion Air
   Mixed Air
   Medium Pressure Supply Air
   Low Pressure Supply Air
   Return Air
   Rigid Round Runouts to Diffusers except any exposed in open ceilings.

6. Other Systems:

   Cold Condensate Drains
   Grease Exhaust Duct (shaft alternative)
   Piping Exposed to Freezing with Heat Tracer where noted on Drawings.

1.3 QUALITY ASSURANCE

A. Qualifications: The firm executing the work of this Section shall have at least 3 years successful installation experience on projects with mechanical insulations similar in scope and nature to that required for this Project.

B. Requirements of Regulatory Agencies: All insulation shall be in accordance with Jurisdicational Building Code and State and Federal Energy Conservation Standards.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of mechanical insulation in accordance with the General Conditions of the Contract. Include schedule showing manufacturer's product number, thickness and furnished accessories for each mechanical system requiring insulation.

B. Provide schedule of pipe sizes with insulation thickness at corresponding fluid temperatures.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver insulation, coverings, adhesives, and coatings to site in containers with manufacturer's stamp or label affixed showing fire hazard ratings of products.

B. Storage of Materials: Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged insulation; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers of insulation materials shall be as follows:

Certain-teed
Owens-Corning
Johns Manville
Armstrong
Knauf
Dow Chemical
3M/Thermal Ceramics (FireMaster)
Unifrax (Fyrewrap)
SpecSeal (Claymac)
Renler (Pyroscat FastR Wrap)
Gilsulate International, Inc. (Gilsulate 500XR Loose-Fill Insulation)
Einsulation

2.2 MATERIALS

A. Conductivity:

TYPE OF INSULATION	**MAXIMUM THERMAL CONDUCTIVITY/INCH**
Calcium Silicate	0.47 at 600 degrees Fahrenheit
Glass Fiber Pipe Insulation	0.25 at 75 degrees Fahrenheit
Glass Fiber Rigid Equipment Insulation	0.25 at 75 degrees Fahrenheit
Glass Fiber Rigid Duct Insulation	0.24 at 75 degrees Fahrenheit
Glass Fiber Blanket Duct Insulation	0.29 at 75 degrees Fahrenheit
Expanded Polystyrene	0.24 at 75 degrees Fahrenheit
Ceramic Fiber Grease Duct Wrap	0.25 at 70 degrees Fahrenheit
Polyisocyanurate Foam	0.19 at 75 degrees Fahrenheit
Granular Loose Fill	See below

B. Duct Wrap: Blanket-type fiberglass insulation 1-1/2" thick, 0.75 pounds per cubic foot density.

C. Grease Duct Wrap: High-temperature ceramic fiber blanket, foil/scrim encapsulation, max-service temp. = 2300°F.

D. Vapor Barrier Coatings: To have a perm rating not more than 0.25 when tested in accordance with ASTM E96, procedure A.

E. Adhesives, Sealers, Facings and Vapor Barrier Coatings: To be compatible with materials to which applied, and shall not corrode, soften, or otherwise attack the pipe or insulation materials in either the wet or dry state. Use only adhesives, sealers, facings, and vapor barrier coatings as recommended by the manufacturer of insulation materials.

F. Chemicals for Treating Paper: Non-soluble.

G. Non-Collapsing Inserts: Calcium Silicate or Polyisocyanurate (Dow Trymer 2000). No Polystyrene inserts are allowed.

H. Granular, Loose-Fill Insulation: Inorganic, nontoxic, nonflammable, sodium potassium aluminum silicate with calcium carbonate filler. Include chemical treatment that renders insulation hydrophobic.

1. Thermal Conductivity (k-Value): 0.60 at 175 deg F and 0.65 at 300 deg F.
2. Application Temperature Range: 35 to 800 deg F.
3. Dry Density: 40 to 42 lb/cu. ft.
4. Strength: 12,000 lb/sq. ft.

2.3 PERFORMANCE CRITERIA

A. Insulation and accessory materials to meet the following criteria:

1. Insulation Materials: To be noncombustible as defined in National Fire Protection Association Pamphlet 220 and to be Underwriter's Laboratory listed.
2. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM E 84 (NFPA 255) method.

2.4 HANDICAP LAVATORY INSULATION

A. Insulation System: Molded closed cell insulation, 3/16-inch nominal wall thickness; provide pre-molded fittings to completely cover tail piece, P-trap, trap arm, hot and cold water supply stop valves and exposed supply tubing; include nylon fasteners for all fittings.

B. Handi Lav-Guard manufactured by Truebro; Trap Wrap manufactured by Brocar Products; Zeston Snap-Trap manufactured by Johns Manville or approved equal.

C. Install at all handicap accessible lavatories installed in this project.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Testing of piping and ductwork to be completed prior to application of insulation.

B. Apply insulation tightly over clean, dry surfaces with sections or edges firmly butted together.

C. Make insulation continuous through sleeves or openings in walls and floors.

D. Run sealed vapor barriers continuous throughout all cold surface insulation systems.

E. Avoid the use of staples on vapor barrier jackets. Seal all vapor barrier penetrations with white vapor barrier sealant.

F. Apply adhesives so as not to exceed the coverages recommended by the manufacturers.

G. Leave surfaces clean and ready for painting.

H. Do not insulate cleanouts, access openings or identification plates. Neatly bevel insulation and finishes up to the edges of such openings and stop with sheet metal rings.

I. Provide non-collapsing inserts between pipe and all shields/saddles on all insulated piping 2-1/2" and larger.

3.2 SPECIFIC INSTALLATION REQUIREMENTS

A. Minimum Pipe Insulation Schedule:

2006 International Energy Conservation Code

PIPE INSULATION THICKNESS IN INCHES*			
	Nominal Pipe Diameter		
Fluid	≤ 1.5”	> 1.5”	> 10”
Hot Water	1.0	2.0	2.0
Glycol, Refrigerant, Condenser Water Systems	1.0	1.5	2.0

*Based on insulation having a conductivity not exceeding 0.27 BTU per inch/h·ft^2·°F.

Exceptions:

1. Factory installed piping within HVAC equipment tested and rated in accordance with 2006 IECC referenced procedures.
2. Piping that conveys fluids that have a design operating temperature range between 55°F and 105°F, unless noted to be insulated on drawings or in specifications.
3. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power, unless noted to be insulated on drawings or in specifications.

4. Runout piping not exceeding 4 feet in length and 1 inch in diameter between the control valve and HVAC coil.

DUCT AND PLENUM INSULATION	
Location	Min. Insulation Value
In unconditioned spaces (i.e. ceiling spaces or unheated spaces)	R-5
Outside building envelope	R-8

Exceptions:

a. When located within equipment.
b. When design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F (i.e. return air ducts in ceiling spaces).

B. Plumbing System:

1. Domestic Cold Water:

Insulate entire system. Thickness per Table of Section 230700, 3.2.A.

2. Roof Drains:

Horizontal mains and vertical from horizontal to and including drain bowls, one-half inch thick fiberglass pipe covering with all service jacket self-seal lap. Overflow rood drain bowls shall be insulated but not overflow drain piping.

3. Domestic Hot and Tempered Supply and Circulating Water:

Insulate entire system.
Thicknesses per table of 230700-3.2, A.

4. Domestic Hot Water Heaters, Storage Tanks, and Accumulators (not factory insulated):

Two inch thick fiberglass board, foil faced or faced with Du-All tank wrap or equal. Finish with six-ounce canvas or fiberglass reinforcing mesh and fire retardant lagging adhesive.

5. Domestic Cold Water Storage Tanks:

Two inch thick fiberglass board foil faced or faced with Du-All tank wrap or equal. Seal all joints with vapor barrier mastic. Finish with six-ounce canvas or fiberglass reinforcing mesh and fire retardant vapor barrier mastic.

6. Chilled Drinking Water:

Thicknesses per Chilled Water Piping System, 40-55 deg. F., of 230700-3.2 A.

7. Fittings:

Premolded PVC fitting covers with Fiberglass insert. PVC covers shall be rated for return air plenum use.

8. Valves:

All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas and heavy coat of vapor barrier mastic coating.

C. Heating System:

1. Heating Water Supply and Return:

a. Fiberglass pipe covering with all-service jacket and self-seal lap.
b. Thicknesses per Minimum Pipe Insulation Schedule in Section 230700-3.2, A.
c. Heat exchangers, convertors, air separators, storage tanks and receivers:

351 deg. and up ..... 4" thick
251 deg. - 350 deg..... 3" thick
up to 250 deg..... 2" thick

Fiberglass pipe covering or Du-All pipe and tank wrap with all service jacket. Finish with six-ounce canvas or fiberglass reinforcing mesh applied with heavy coat of lagging adhesive where subject to abuse.

2. Fittings:

a. Premolded PVC fitting covers with Fiberglass insert.

3. Valves:

a. All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas or fiberglass reinforcing mesh and heavy coat of vapor barrier mastic coating.

D. Chilling System:

1. Fiberglass pipe covering with all service jacket self-seal lap.

2. Condenser Water: Thicknesses per Condenser Water Piping System of Section 230700-3.2 A.

3. Fittings:

All systems: Premolded PVC fitting covers with fiberglass insert. Seal all fittings at end and throat.

4. Valves:

All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas or fiberglass reinforcing mesh and heavy coat of vapor barrier mastic coating.

5. Cold Condensate Drain Piping:

   1/2" thickness fiberglass pipe covering with all service jacket self-seal lap.

6. Refrigerant Suction and Liquid Piping: Thicknesses per Refrigerant Piping System of Section 230700 - 3.2, A.

   Fiberglass pipe covering with all service jacket self-seal lap. At Contractor's Option, a closed cell insulation with all joints butted and cemented may be used in lieu of fiberglass. Armaflex 22 or equal. If closed cell insulation is exposed to sunlight, coat all surfaces with UV protection to prevent long term deterioration from sunlight.

7. Refrigerant Hot Gas Piping:

   1" thickness fiberglass pipe covering with all service jacket self-seal lap, or 3/4" thick closed cell insulation. This is for safety purposes only, not for thermal efficiency.

8. Cold Water Thermal Storage Tanks and Chilled Water Storage Tanks:

   2” thick fiberglass board, foil faced or faced with Du-All pipe and tankwrap. Seal all joints with vapor barrier mastic. Finish with six-ounce canvas or fiberglass reinforcing mesh and fire retardant vapor barrier mastic.

E. Buried Piping:

1. Do not disturb the bottom of trench, or compact and stabilize it to ensure proper support.
2. Remove any standing water in the bottom of trench.
3. Form insulation trench by excavation or by installing drywall side forms to establish required height and width of the insulation.
4. Support piping with proper pitch, separation, and clearance to backfill or side forms using temporary supporting devices that can be removed after back filling with insulation.
5. Place insulation and backfill after field quality-control testing has been completed and results approved.
6. Apply bitumastic coating to carbon-steel anchors and guides. Pour concrete thrust blocks and anchors.
7. Wrap piping at bends, expansion loops, and offsets with mineral-wool insulation of thickness appropriate for calculated expansion amount.
8. Pour loose-fill insulation to required dimension agitating insulation to eliminate voids around piping.
9. Remove temporary hangers and supports.
10. Cover loose-fill insulation with polyethylene sheet a minimum of 4 mils (0.10 mm) thick, and empty loose-fill insulation bags on top.
11. Manually backfill 6 inches (150 mm) of clean backfill. If mechanical compaction is required, manually backfill to 12 inches (300 mm) before using mechanical-compaction equipment.

F. Refrigerant System:

1. Expanded polystyrene pipe covering with all service jacket and self-seal lap.

2. Refrigerant piping and brine piping: Insulate with thickness per Section 230700-3.2, A. Thickness over 2-1/2 inch may be applied in two layers. Ends of inner layer sections shall be staggered and taped. End and longitudinal joints of outer layer shall be staggered with inner layer joints. Secure with 1-inch fiberglass filament tape 12 inches on center. Provide factory applied all service jacket on outer layer. Seal all ends of insulation runs.
3. Valves and Fittings: Pre-molded covers fabricated of same material and thickness as pipe insulation. Fill gaps with injected foam insulation. Secure covers with 1 inch fiberglass filament tape.
4. Vessels: Insulate with two layers of prefabricated curved segments to fit vessel. Stagger all joints. Secure with banding 18 inches on center. Extend side insulation past tank head to thickness of insulation, insert circular end insulation. Fill voids with injected foam insulation.
5. Brine pumps: Pumps shall be insulated with 2-inch total thickness of flexible expanded elastomeric insulation, install to allow for maintenance access to pump.

G. Air Distribution System:

1. Exterior surfaces of outside air, combustion air, mixed air, and recovery coil discharge:

   One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins or stick clips.

2. Exterior surfaces of supply and return air plenums where not indicated to be lined:

   One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins.

3. Exterior surfaces of exposed supply ductwork not lined:

   One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins or stick clips.

4. Concealed supply ductwork not lined:

   One and one-half inch thick 0.75 pound fiberglass duct wrap with foil scrim facings. All joints sealed. Apply material with adhesive or wire 18 inches o.c.

5. Low pressure round runouts to diffusers:

   One and one-half inch thick 0.75 pound fiberglass duct wrap with foil scrim facings. All joints sealed. Apply material with adhesive or wire 18 inches o.c.

6. See Specification Section 230540 – Mechanical Sound and Vibration Control for requirements for lined ductwork.

H. Other Systems:

1. Piping Exposed to Freezing with Heat Tracer:

   One-inch thick fiberglass pipe covering with all service jacket-self seal lap. Finish with 0.016-inch thick corrugated aluminum jacket and fitting covers for protection.

   NOTE: Insulation shall be applied over heat tracer.

2. Piping Insulation Exposed to Rainfall:

   Provide 0.016-inch thick corrugated aluminum jacket and fitting covers on all insulation exposed to rainfall. Install seam on bottom of horizontal and angled piping. Seal all joints weather-tight. Seal jacket seams with silicone sealant.

3. Protective Insulation Jacketing:

   Provide high impact polyvinyl chloride pipe covering on insulated piping that is exposed in mechanical rooms and in chiller rooms. Thickness to be 30 mil. Install where noted on drawings and per manufacturer's recommendations for hot and cold piping systems. Seal using solvent welding adhesive, providing slip joints as required for expansion and contraction. Ceel-Co Ceel-Tite 300 series, Schuller Zeston 300 series, or approved equal.

4. Grease Duct (Shaft Alternative):

   One and one-half inch thick ceramic fiber duct wrap meeting ASTM E 119 performance standard from top of hood to roof/wall penetration. Apply in accordance with manufacturer’s instructions. Provide two layers of duct wrap as alternative to rated shaft. Secure with 3/4" stainless steel banding. Provide insulated covers at grease duct access doors and cleanouts.

6. Condensate Drains Inside Buildings:

   1/2" thickness fiberglass pipe covering with all service jacket self-seal lap.

END OF SECTION 230700

SECTION 23 08 00 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The purpose of the commissioning process is to provide the Owner/operator of the facility with a high level of assurance that the mechanical and associated electrical Systems have been installed in the prescribed manner, and operate within the performance guidelines set in the design intent. The Commissioning Authority shall provide the Owner with an unbiased, objective view of the systems installation, operation, and performance. This process is not to take away or reduce the responsibility of the design professionals or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The Commissioning Authority will be a member of the construction team, cooperating and coordinating all commissioning activities with the design professionals, construction manager, contractors, subcontractors, manufacturers and equipment suppliers.

1.2 SCOPE

A. The HVAC systems commissioning shall include a demonstration by the Contractor of each equipment control sequence. The commissioning process shall demonstrate that each control sequence (including alarms and lead/lag equipment operations) and the associated test and balance data all correspond with the contract documents and with the final test and balance report. The finalized temperature control software with graphic displays shall be installed and operational (at all required locations) and the final test and balance report shall be provided for review and acceptance by the Owner and the Engineer a minimum of 10 days prior to requesting date(s) for the HVAC systems commissioning. Additionally, the temperature control contractor and the test and balance contractor (along with any other necessary parties) shall complete a 'dry-run commissioning' and shall certify in writing that all equipment is operating in accordance with the finalized written control sequences prior to requesting date(s) for the actual official on-site HVAC systems commissioning session(s).

B. The HVAC systems commissioning shall demonstrate that the quantities read and displayed by the control system are in agreement with actual' tested quantities (e.g.. variable air volume box cfm readings. minimum outside air cfm readings. air temperatures. water temperatures. duct static pressures, building static pressures, etc.). The HVAC systems commissioning shall also demonstrate that all quantities listed in the final test and balance report (cfm readings. gpm readings. temperature differences, pressure drops. etc.) are/were correctly reported.

C. The Contractor shall schedule a pre-commissioning pre-balancing meeting with the Owner's representatives at least two weeks prior to beginning the testing and balancing. This meeting will be utilized to review and discuss the finalized control sequences and to verify specific testing and balancing requirements. The final approved temperature control sequences will be distributed and reviewed during this meeting. The final control sequences will include additional detail and/or modifications to the original sequences contained in the contract documents (since such details are commonly omitted from the Mechanical Engineer's original written control sequences and are developed after the equipment submittals and the temperature control system submittals are received). The work associated with those additions and: or modifications shall be provided by the temperature control contractor and the test and balance contractor at no additional cost to the Owner.

D. The Contractor shall furnish a set of two-way radios which will be utilized to expedite the commissioning process (typically a minimum of 3 fully charged radios will be necessary and required for the duration of the commissioning process).

E. The demonstration of each control sequence shall be performed under conditions which simulate as close to an actual condition as possible. The Contractor shall provide all necessary materials and temporary system modifications as required to 'false-load' the system(s) as required to demonstrate the desired sequences (including appropriate gas required to simulate a refrigerant leak in the chiller room when applicable). The temperature control system software shall be capable of temporarily overriding analog inputs in order to facilitate demonstration of the temperature control sequences. In cases where the project does not include an on-site computer in the building being commissioned the temperature control contractor shall provide a laptop computer equipped with the complete graphic interface software package (the software on the laptop computer shall be identical with the software provided to the Owner).

F. HVAC systems commissioning shall be conducted with representatives from the following entities (the required participants shall be confirmed with the State Public Works Board mechanical engineer prior to scheduling the commissioning).

1. General Contractor (with a complete set of plans and specifications).
2. Mechanical Contractor (with a complete set of mechanical equipment operating and maintenance manuals).
3. Temperature Control Contractor (with a laptop computer loaded with the finalized programming and graphic interface software).
4. Test and Balance Contractor (with a complete set of testing apparatus as utilized during testing and balancing and a complete copy of the final test & balance report).
5. Factory-authorized technicians for all major equipment (chillers, boilers, cooling towers, variable frequency drives, etc.). Technicians shall be available to verify equipment start-up has been properly completed and to make any necessary or desired adjustments to control settings.
6. Water Treatment Contractor (with copies of final water treatment reports).
7. Mechanical Engineer and or his designated representative.
8. State Public Works Board's designated representative.

G. The aforementioned representatives shall be present during all portions of the testing (and re-testing as required) and shall be equipped to promptly remedy any deficiencies discovered during the commissioning process.

H. The temperature control contractor and the test and balance contractor (along with any other necessary parties) shall conduct a 'dry-run commissioning' to verify that all of the previously listed commissioning requirements are complete prior to requesting a date for the actualiofficial on-site commissioning session(s).

I. Should any of the aforementioned requirements not be met on the date that the commissioning process commences and or if deficiencies are observed during the commissioning process the commissioning will be considered a failure and the deficiencies will be required to be remedied and then addressed in writing prior to requesting a date for re-commissioning. There will be no additional costs allowed to the Contractor for re-commissioning sessions as may be required to address issues that are found to be in non-compliance with the requirements of this specification.

J. The Contractor shall include adequate time periods for both the 'dry-run commissioning' and the actual official on-site commissioning in the project schedule. The necessary time periods shall be carefully reviewed with all of the appropriate subcontractors to ensure that the subcontractors are in agreement with the time allotted for each scheduled task.

K. Completion and acceptance of the HVAC systems commissioning shall be a condition of Substantial Completion. The building shall be considered 'not ready to utilize for its intended use' until such time that the HVAC systems commissioning is successfully completed.

L. The responsibilities of the Contractor shall also include:

1. Coordinate and manage the Contractors commissioning activities.
2. Coordinate directly with each subcontractor and vendor with respect to their responsibilities and contractual obligations for commissioning.
3. Attend periodic on-site commissioning meetings
4. Integrate commissioning schedule into the master construction activity schedule. Update schedule at specified intervals.
5. Contractors shall provide the CA with normal cut sheets and shop drawing submittals of commissioned equipment.
6. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up and functional testing procedures.
   (1) Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.
   (2) The Commissioning Agent may request further documentation necessary for the commissioning process.
   (3) This data request may be made prior to normal submittals.Conduct installation verification inspections.
7. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
8. Review controls documentation and interface with other systems.
9. Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review and approval.
10. Note any inconsistencies or deficiencies in system operations. Enforce system compliance or recommend to the owners Representative modifications to system design that will correct or enhance system performance.
11. Coordinate Commissioning Authority test witnessing, after verifying that pretests have been satisfactorily conducted and final tests are ready to be performed.
12. Be present during training sessions to direct video recording, present training and direct the presentations of others.
13. Be present during start-up activities to direct and witness execution of start-up.
14. Monitor performance of testing, adjusting and balancing activities to ensure acceptable results, and use of approved methods and instrumentation.
15. Ensure that necessary test instrumentation is available during verification and functional performance testing, and that instruments meet quality and calibration requirements and are in good working order.
16. Be present during verification and functional performance testing and retesting to direct and witness execution of tests.
17. In the event that a commissioning test fails, determine the cause of failure, direct timely correction of deficiency and then retest. Reimburse the Owner for billed costs for the extraordinary participation of the Owners Representative, Architect, Commissioning Authority and owners staff.
18. Track commissioning deficiencies until correction and retesting is successfully completed.

19. Warranty Period
    (1) Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
    (2) Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

M. The functions and responsibility of the Commissioning Authority shall include:

1. Responsibility: The primary point of responsibility is to inform the Contractor and the Owner on the status, integration, and performance of systems within the facility.
2. Information: The Commissioning Authority shall function as a catalyst and initiator to disseminate information and assist the design and construction teams in the completion of the construction process. This shall include system completeness, performance, and adequacy to meet the intended performance standards of each system. Services include construction observation, spot testing, verification and functional performance testing, and providing performance and operating information to the responsible parties, e.g., contractors, design professionals, and the Owner.
3. Quality Assurance: Assist the responsible parties to maintain a high quality level of installation and system performance.
4. Observation of tests: Commissioning Authority shall observe and coordinate testing as required to ensure system performance meets the design intent.
5. Documentation of tests: Commissioning Authority shall document the results of the performance testing directly and/or ensure that all testing is documented by the appropriate technicians. The Commissioning Authority shall provide standard forms to be used by all parties for consistency of approach and type of information to be recorded.
6. Resolution of disputes: The Commissioning Authority is to remain an independent party present on the project with specific knowledge of the subject. Should disputes arise, the Commissioning Authority shall perform research to determine the scope and extent of the problem and educate the involved parties as to the nature and extent of the problem. This shall include technical and financial aspects of the dispute, including assistance to help identify who the responsible parties are to implement corrective action. The Owner/Architect shall preside over resolution of the problem.
7. Deficiencies: Provision of technical expertise to oversee and verify the correction of deficiencies found during the commissioning process.
8. Provision of technical expertise to review and edit operating and maintenance descriptions by system.

1.3 SYSTEMS TO BE INCLUDED IN COMMISSIONING PROCESS

A. The following pieces of equipment and systems shall go through commissioning:

1. Building HVAC System and Controls
2. Plumbing Systems
3. Fume Hoods

1.4 COORDINATION

A. The Commissioning authority shall receive a copy of all construction documents, addenda, change orders, and appropriate approved submittals and shop drawings directly from the Architect and Contractor.

B. The Commissioning Authority shall disseminate written information and documents to all responsible parties relative to the nature and extent of the communication.

C. The Commissioning Authority is primarily responsible to the Owner, and as such, shall regularly appraise the Architect, the Contractor, and the Owner of progress, pending problems and/or disputes, and shall provide regular status reports on progress with each system. Any potential change in the contractual and/or financial obligations of the owner (credits, change orders, schedule changes, etc.) shall be identified and quantified as soon as possible.

D. The Commissioning Authority shall coordinate the schedule of commissioning activities with the construction schedule. It is possible that some procedures will be completed before the entire Mechanical system is completed.

1.5 SCHEDULE

A. Commissioning of systems shall proceed per the criteria established, in the specific sections that follow, with activities to be performed on a timely basis. The Commissioning Authority shall be available to respond promptly to avoid construction delays.

B. Start-up and testing of systems may proceed prior to final completion of systems to expedite progress. However, the Commissioning Authority shall not perform testing and checkout services that are the primary responsibility of the contractor/vendor in advance of their testing and checkout.

C. Problems observed shall be addressed immediately, responsible parties notified, and actions to correct deficiencies coordinated in a timely manner.

D. Contractor schedules and scheduling is the responsibility of the Contractor. The Commissioning Authority shall provide commissioning scheduling information to the Contractor for review and planning activities.

E. The following list is a general set of tasks and criteria along with an approximate duration for each task. This list is intended to be utilized as a guideline for creating an appropriate schedule for all of the work related to HVAC systems commissioning. The actual time required for each task will vary depending on the size and complexity of the mechanical systems on the particular project. Determination of the actual time required for each task is the responsibility of the Contractor and shall be developed utilizing thorough review and discussion with all of the involved subcontractors prior to preparing and submitting the proposed schedule. A typical project requires between 4 and 8 weeks from start of test and balance to scheduling the dates for the formal on-site commissioning session(s).

1. Pre-commissioning/pre-balancing meeting (2 weeks prior to start of testing and balancing).
2. Begin testing and balancing (typically a 1 to 2 week process).
3. Print and distribute final test and balance reports (typically a 1 to 2 week process).
4. Temperature control contractor (with participation from test and balance contractor and mechanical contractor as necessary) conducts 'dry-run commissioning' (utilizing the State Public Works Board 'HVAC Systems Commissioning Checklist' as a guide) and tunes all control loops (typically 1 to 2 week process). Note that this task occurs after testing and balancing is complete.
5. State Public Works Board conducts pre-commissioning review via telephone modem interface (typically a 1 to 2 week process). Note that this task occurs after testing and balancing is complete and after 'dry-run commissioning' is complete, and requires that the dedicated telephone line be in place.

6. Schedule formal on-site HVAC systems commissioning dates (typically a 1 to 3 day process).

1.6 RELATED WORK SPECIFIED ELSEWHERE

A. Commissioning requires support from the contractors. The commissioning process does no relieve any contractors from their obligations to complete all portions of work in a satisfactory manner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COMMISSIONING PLAN AND SCHEDULE

A. The Commissioning Authority shall develop and submit a schedule for the commissioning process which is integrated with the construction schedule. Included shall be the required work by all team members (Commissioning Authority, design team, contractors, and the Owner). Overlay with the construction schedule, and include time for test and balance, verification, and functional performance testing.

3.2 CONSTRUCTION OBSERVATION

A. This is and additional and separate activity from that provided by the design team. Construction observation is required as part of the commissioning and coordination process provided by the C/A.

3.3 TEST AND BALANCE

A. Air & water balance shall be accomplished by the test and balance firm. The Commissioning Authority shall spot check this work to verify accuracy of results.

3.4 VERIFICATION AND FUNCTIONAL PERFORMANCE TEST PROCEDURES

A. Commissioning Authority shall develop and document the commissioning procedure to be used. Include a performance checklist and performance test data sheets for each system based on actual system configuration. These procedures shall be reviewed by the appropriate design engineers for technical depth, clarity of documentation and completeness. Emphasis shall be placed on testing procedures that shall determine actual system performance and compliance with the design intent.

B. The majority of mechanical equipment requires safety devices to stop and/or prevent operation unless minimum safety standards or conditions are met. These may include adequate oil pressure, proof-of-flow, non freezing conditions, maximum static pressure, maximum head pressure, etc. The Commissioning Authority shall observe the actual performance of safety shutoffs in a real or closely simulated condition of failure.

C. Systems may include safety devices and components that control a variety of equipment operating as a system. Interlocks may be hard-wired or operate from software. Operation of these interlocks shall be verified by the Commissioning Authority.

D. The Commissioning Authority shall determine the acceptance procedures for each system within Division 15. The acceptance procedures shall incorporate the commissioning standards and successful testing results as referred to throughout Division 15 and 16 specifications.

1. In particular, the temperature control system shall have all 1/0 points individually verified for proper function, calibration, and operation. The Commissioning Authority shall review proposed testing procedures and report formats, and observe sufficient field testing to confirm that all 1/0 points have been properly tested.
2. All control sequence of operation strategies, alarm generation and reporting shall also be reviewed and proper operation verified by the Commissioning Authority.
3. The central work station graphics, point assignments, alarm messages, and logging functions shall be verified.

E. The appropriate contractor and vendor(s) shall be informed of what tests are to be performed and the expected results. Whereas some test results and interpretations may not become evident until the actual tests are performed, all parties shall have a reasonable understanding of the requirements. The Commissioning Plan shall address those requirements and be distributed to all parties involved with that particular system.

F. Acceptance procedures shall confirm the performance of systems to the extent of ' the design intent. When a system is accepted, the Owner shall be assured that the system is complete, works as intended, is correctly documented, and operator training has been performed.

3.5 HVAC SYSTEMS COMMISSIONING CHECKLIST

- ☐ Review location of outside air temperature sensor.
- ☐ Verify: calibrate outside air sensor (dry bulb & relative humidity). Verify wet bulb temperature calculation.
- ☐ Verify location of building static pressure sensor(s).
- ☐ Verify calibrate building static pressure sensor(s).
- ☐ Verify building static pressure control sequence.
- ☐ Verify; calibrate duct static pressure sensor(s).
- ☐ Verify minimum outside air control sequences (measure outside air).
- ☐ Verify programming of minimum outside air damper positions.
- ☐ Verify programming of return fan offsets.
- ☐ Verify outside air economizer control sequence and operation.
- ☐ Verify all valves and dampers have been programmed to operate without hunting.
- ☐ Verify programming of vfd's (minimum speed, auto restart, input/output speed calibration, alarm on failure, upward and downward ramp time settings).
- ☐ Verify vav box maximum, minimum, and reheat cfm air flows (random verification).

- ☐ Verify vav box discharge air temperature (in both heating and cooling modes).
- ☐ Verify diffuser air flows at vav box maximum cfm (random verification).
- ☐ Verify set-up of all required alarms (review automatic dial or automatic e-mail set-up).
- ☐ Verify calibration of air filter alarms.
- ☐ Verify set-up of occupancy schedules.
- ☐ Verify set-up of holiday schedules.
- ☐ Verify unoccupied mode operation (damper and valve positions).
- ☐ Verify night set-back (heating) control sequence.
- ☐ Verify night set-back (cooling) control sequence.
- ☐ Verify morning warm-up control sequence.
- ☐ Verify room sensor programming. displays. and calibration.
- ☐ Verify room sensor unoccupied mode override feature.
- ☐ Verify pump lead/lag programming and alarm display.
- ☐ Verify boiler lead/lag programming and alarm display.
- ☐ Verify chiller lead/lag programming and alarm display.
- ☐ Verify boiler integral control setpoints.
- ☐ Verify chiller integral control setpoints.
- ☐ Verify plate heat exchanger approach and pressure drop.
- ☐ Verify central cooling plant changeover sequence (from heat exchanger to chiller).
- ☐ Verify operation of 3-way valve at chiller condenser (verify actuator stroke time).
- ☐ Verify pump head and gpm (compare test/ balance report to design).
- ☐ Verify cooling tower fill. drain. and overflow settings; operation.
- ☐ Verify that cooling tower does not overflow on pump shut-down.
- ☐ Verify cooling tower sump heater power and control arrangement.
- ☐ Verify that cooling tower sump is clean.
- ☐ Review water treatment reports for each water system.
- ☐ Verify that pump strainers are clean.
- ☐ Verify flow at heating and cooling coils (random verification).
- ☐ Verify location installation of air vents in each closed loop piping system.

- Verify chiller room emergency shut-down switch locations and operation.
- Verify chiller room refrigerant leak sensor operation.
- Verify boiler room emergency shut-down switch locations and operation.
- Verify that air handling unit compartments are clean.
- Verify that mechanical system roof penetrations are properly installed (per roofing details).
- Verify global. remote, and local room setpoint functions.
- Verify adjustment range for local room temperature setpoints.
- Verify equipment room temperature setpoints and deadbands.
- Verify bleed rate on each evaporative cooler and or evaporative cooling section.
- Verify chemical treatment provisions at each evaporative cooler and or evaporative cooling section.
- Verify that all required spare parts (filters. belts. etc.) have been provided.

- Verify acceptable air and noise levels throughout the building.
- Verify duration of water flow at self-closing lavatory faucets.
- Verify time delay before domestic hot water is available at lavatory faucets.

3.6 FUNCTIONAL PERFORMANCE TESTING - OBSERVATION

A. The functional performance testing shall be done by the Contractor. The Commissioning Authority shall direct and witness all of these tests. -

B. Tests shall be completed comprehensively and to the extent necessary to enable the Commissioning Authority to assure the Owner and design professional that the systems do perform per the design intent.

3.7 RE-TESTTNG

A. Contractor shall, at no additional cost to the Owner, repeat the complete verification test procedure for each test for which acceptable results are not achieved. Repeat tests until acceptable results are achieved.

B. Contractor shall compensate the Owner for costs incurred as the result of tests repeated. This includes the costs for the Commissioning Authority, Design Architect, Design Engineers, and Owner--s personnel.

3.8 CORRECTION OF DEFICIENCIES

A. Correct functional performance test deficiencies promptly and schedule retest.

B. Corrections during verification or functional performance test are generally prohibited to avoid consuming the time of personnel waiting for the test~ but not involved in making the correction. Exceptions will be allowed if the cause of the failure is obvious and corrective action can be completed in less than five minutes. If corrections are made under this exception. the failure shall be noted on the test data form. A new test data form, marked retest, shall be initiated after the correction has been made. The entire test procedure shall be repeated.

3.9 SOFTWARE DOCUMENT

A. Review detailed software documentation for all DDC control systems. This includes review of vendor documentation, their programming approach and the specific soft-ware routines applied to this project. Discrepancies in programming approaches and/or sequences shall be reported and coordinated in order to provide the Owner with the most appropriate, simple, and straightforward approach to software routines.

3.10 OPERATING AND MAINTENANCE (O&M) MANUALS

A. The Commissioning Authority shall review the draft form of the O&M manuals provided by the Division 15 contractor and the Division 16 contractor. The review process shall verify that O&M instructions meet specifications and are included for all equipment furnished by the contractor, and that the instructions and wiring diagrams are specific (edited where necessary) to the actual equipment provide for this project.

B. Published literature shall be specifically oriented to the provided equipment indicating required operation and maintenance procedures, parts lists, assembly/disassembly diagrams, and related information.

C. The contractor shall incorporate the standard technical literature into system specific formats for this facility as designed and as actually installed. The resulting O&M information shall be system specific, concise, to the point, and tailored specifically to this facility. The Commissioning Authority shall review and edit these documents as necessary for final corrections by the contractor.

D. The O&M manual review and coordination efforts shall be completed prior to Owner training sessions, as these documents are to be utilized in the training sessions.

3.11 TRAINING

A. Schedule and coordinate training sessions for the Owner’s staff for each system. Training shall be in a classroom setting with the appropriate schematics, handouts, and visual/audio training aids on-site with equipment.

B. The Commissioning Authority organizes, schedules, and directs the training sessions.

C. The appropriate installing contractors shall provide training on all the major systems per specifications, including peculiarities specific to this project.

D. The equipment vendors shall provide training on the specifics of each major equipment item including philosophy, troubleshooting, and repair techniques.

E. The automatic control vendor shall provide training on the control system per their specification section.

3.12 RECORD DRAWINGS

A. The Commissioning Authority shall review the as-built contract documents to verify incorporation of both design changes and as-built construction details. Discrepancies noted shall be corrected by the appropriate party.

3.13 EXCLUSIONS

A. Responsibility for construction means and methods: The Commissioning Authority is not responsible for construction means, methods, job safety, or any, construction management functions on the job site.

B. Hands-on work by the Commissioning Authority: The contractors shall provide all services requiring tools or the use of tools to start-up, test, adjust, or otherwise bring equipment and systems into a fully operational state. The Commissioning Authority shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing, and control function.

END OF SECTION 230800

SECTION 230810 - VARIABLE FREQUENCY DRIVE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The contractor shall furnish and install a complete Variable Frequency Drive and Energy Efficient motor system on the following equipment as described in this specification and as indicated on the drawings.

1. Domestic Hot Water Injection
2. Cooling tower fans
3. Heat Pump Loop

B. The Variable Frequency Drive shall convert 480 volt (verify with equipment ordered), three phase, 60 Hz utility power to adjustable voltage and frequency, three phase, A-C power for stepless motor control from 6 to 60 Hz.

C. This contractor shall coordinate motor selection with Variable Frequency Drive.

D. Variable Frequency Drive Systems shall be compatible with any standard NEMA B or C design 3-phase induction motor. Variable Frequency Drive Systems shall be sized to insure the motor full load amps does not exceed the controller continuous RMS amps at project altitude (4500 ft.).

E. VFD shall be BACNET compliant and shall be interfaced to the BACNET network specified under Section 230900. The VFD shall be N^2 compatible or include integrator as required for complete integration into Owner's system and network interface shall conform to the BACNET Functional Profile for variable speed motor drives. All of the standard network variables listed in the functional profile shall be interfaced to the BACNET network.

1.2 QUALITY ASSURANCE

A. The equipment supplied under this specification shall conform to the latest applicable codes and standards of the following:

1. NEC – (NFPA 70) – National Electric Code.
2. ANSI/NEMA ICS 6 – Enclosures for Industrial Controls and Systems.
3. NEMA AB1 – Molded Case Circuit Breakers.
4. NEMA ICS 2 – Industrial Control Devices, Controllers, and Assemblies.
5. IEEE Standard 519-1992 – Recommended Practices for Harmonic Control in Electrical Power Systems.
6. ANSI C37 – Standards for Circuit Breakers, Switchgear, Relays, Substations and Fuses.
7. ANSI C57 – Distribution, Power, and Regulating Transformers (includes Reactors).
8. UL 508C – Power Conversion Equipment.
9. NEMA ICS 3.1 – Safety Standards for Construction and Guide for Selection, Installation, and Operation of Variable Frequency Drive Systems.
10. FCC CFR 47 Part 15 subpart B.

11. State of Utah DFCM Standards.

B. The VFD's shall be UL listed for conformance to UL-508C. An equivalent safety labeling program by ETL or CSA documenting compliance with these industry standards will be acceptable.

C. The Division 23 Contractor shall coordinate and assume system responsibility and compatibility between the various approved suppliers' equipment and services required to meet these specifications.

D. The VFD system vendor shall provide a complete parts and labor warranty (including travel and shipping expenses) for one (1) year from the date of substantial completion. The warranty shall cover the entire VFD system including power devices, controllers, filters, communications interface, etc. furnished as part of the system package.

E. The mechanical contractor shall coordinate the mounting location of the VFD with the electrical contractor to be certain that it is not mounted in the airstream of unfiltered exhaust air; i.e. in a parking garage application.

1.3 SUBMITTALS

A. Shop Drawings: Submit shop drawings and product data in accordance with Section 230500 – Basic Mechanical Requirements.

1. VFD: Product data sheets, functional descriptions, performance ratings, dimensions, conduit entry/exit locations, installation instructions, complete wiring diagrams for power, controls, etc.
2. Control System Interface: Furnish complete documentation of the controls system interface including bus specification, object list, wiring diagrams, XIF or configuration files, etc.
3. Derate calculation for installation altitude above 3300 ft. and ambient temperature above 40°C.

B. Operating Instructions and Maintenance Data: Submit printed operating instructions and maintenance data in accordance with Section 230500 – Basic Mechanical Requirements.

1. VFD: Operating and Maintenance instructions, programming instructions, spare parts lists, troubleshooting instructions.
2. Factory test reports.
3. Start-up and commissioning reports.
4. Power quality test reports.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. The following manufacturers are acceptable, submit alternates for prior approval in accordance with the General Conditions and Division 1 Requirements.

1. ABB
2. Yaskawa
3. Graham/Danfoss

4. Mitsubishi
5. Grundfos Inc.

2.2 CONSTRUCTION, VARIABLE FREQUENCY DRIVE

A. The Variable Frequency Inverter(s) shall be PWM type using IGBTs, rated for the motor type, horsepower, and voltage as indicated on drawings.

B. The Inverter shall be altitude compensated and sized for the elevation at which the unit will be installed. The inverter shall operate in an ambient temperature of –10°C to 50°C humidity of 0-90% non-condensing.

C. The VFD system manufacturer shall integrate all components and equipment required to meet these specification features and functions as a single UL (or equivalent) labeled system. Vendors providing equipment requiring panel shop or job site modifications or additions that would not be valid under the original equipment manufacturer's (OEM's) safety labeling will not be acceptable.

D. Pre-integrated equipment shall include but not be limited to incoming line filters, rectifier units, inverter units, control circuitry, operator interfaces, protective equipment, and other accessories and auxiliary items necessary to meet the highest standards for the type of service specified herein.

E. All VFD system components shall be housed in a grounded, dead front, free-standing or wall mounted, NEMA 1 enclosure. The VFD system size shall not exceed the size allotments specified on the drawings nor shall any portion of the system exceed a height of 90 inches. Entry shall be provided for incoming line and load cables as required or as shown on the drawings.

F. VFD systems mounted indoors shall be properly ventilated and sized to operate continuously at the job site elevation in an ambient environment of 0°C to 40°C, 0-90% RH. VFD systems mounted outdoors shall include environment control provisions as required (or as shown on the plans) to operate in an ambient of –30°C to 50°C, 0-100% RH.

G. All components of the VFD system shall be selected to operate continuously without any system trip or damage based on the nominal power specifications and requirements shown on the drawings or schedules. The above conditions must be maintained under the following expected variations:

1. Plus or minus 10% voltage fluctuation.
2. Plus or minus 3% frequency variation (5% if served by a back-up generator).
3. Distorted voltage waveform with up to 7% total voltage harmonic distortion.

H. The VFD system shall employ voltage sag ride-through coordination under normal operating (average load) conditions to prevent nuisance trips with the following utility interruptions:

1. 0% voltage for 1 cycle.
2. 60% voltage for 10 cycles.
3. 87% voltage continuous.

I. The VFD system shall employ door mounted industrial control operator devices, programming unit, and other devices as required to meet all functional and feature requirements of this specification. Operator pilot lights or LEDs, switches and pushbuttons (if required) shall be industrial oil tight industry standard devices.

J. Control voltages shall be 120 volts or less supplied by machine tool type transformers employing both primary and secondary fusing.

K. The VFD system factory wiring shall be permanently marked with hot emboss stamping or an equivalent marking system. All devices shall be labeled and identified with correct setting selections. All component identification and wiring shall be documented in the operation and maintenance manual.

L. The VFD system shall be capable of starting and continuously driving the specified maximum motor load as identified on the drawings and schedules.

M. VFD's driving variable torque loads shall be programmed to optimize load patterns which maximize system efficiency and minimize motor heating and stresses. VFD's driving constant torque or other loads shall be programmed to optimize load patterns for system or process performance as required.

N. All VFD systems shall have an overload capacity of a minimum of 120% for one minute.

O. The VFD solid state converter and inverter power switching components and control shall be selected to achieve a 0.95 efficiency or better at full load and speed. Other auxiliary devices required on the drawings or in these specifications including filters, line reactors, cooling or heating devices etc. shall be of a design to optimize efficiency as intended under this specification.

P. The entire true system power factor (as measured at the input to the VFD system) shall be 0.95 or better across the operational speed and load range. Power factor that becomes leading under light load conditions (due to PF correction) is acceptable only if voltage rise is prevented from backfeeding to the rest of the system (meaning PF correction must act like a synchronous condenser). The voltage tolerance at the main VFD system input terminals shall not be compromised as a result of power factor correction techniques.

Q. Short circuit protection shall be provided to the VFD system through an externally operated, door interlocked fused disconnect, circuit breaker or motor circuit protector (MCP). VFD shall have a minimum short circuit rating of 65,00 amps RMS (100,000 amps RMS with DC bus reactor) without additional input fusing. The door interlocked handle must be capable of being locked off to meet NEC.

R. Overcurrent protection shall be provided in the VFD system through electronic motor overload (MOL) circuits with instantaneous trip, inverse time trip, and current limit functions. These shall be adjustable and optimized for the application.

S. In addition to the overcurrent protection above, the VFD system shall provide over and under voltage protection, over temperature protection, ground fault protection, and control or microprocessor fault protection. These protective circuits shall cause an orderly shutdown of the VFD, provide indication of the fault condition, and require a manual reset (except undervoltage) before restart. Undervoltage from a power loss shall be set to automatically restart after return to normal. The history of the previous three faults shall remain in memory for future review.

T. The VFD system customer terminations shall be clearly identified with terminal numbers and a permanent wiring diagram located in the VFD system enclosure. Coordinate all control work with Section 230900 Contractor.

U. VFD shall meet the requirements for Radio Frequency Interference as specified by FCC Regulations, Part 15, Subpart J, Class A devices.

2.3 FEATURES, VARIABLE FREQUENCY DRIVES

A. The following operator control and indication features shall be provided standard (unless shown differently on the drawings) as part of each VFD system, all pilot lights to be L.E.D. type:

1. Hand-Off-Auto (local start at VFD, remote start with contact closure).
2. Local-Remote speed control (local speed control at VFD, remote speed control through speed reference signal).
3. Frequency (speed) indication.
4. Motor voltage indication.
5. Motor current indication.
6. VFD run indication.
7. VFD fault and diagnostic indication.

B. The following customer connections and interface terminations shall be provided standard (unless shown differently on the drawings) as part of each VFD system:

1. VFD remote start/stop connection.
2. External safeties connection.
3. VFD run annunciation.
4. VFD fault annunciation.
5. VFD speed reference input connection (4-20mA or as shown on drawings).
6. Minimum of three (3) programmable digital inputs.
7. Minimum of two (2) 4-20mA input signals to integral controller.

C. The following parameter adjustments shall be available to tune the VFD system:

1. Minimum and maximum speeds.
2. Acceleration and declaration times.
3. Overcurrent trip point.
4. Current limit response to overload.
5. Maximum base motor voltage.
6. Input speed reference signal gain and bias.
7. Output speed reference signal gain and bias.
8. Critical frequency avoidance.
9. Multiple preset speed programming.
10. Integral PI controller programming.

D. The VFD shall be capable of starting into a rotating motor at any speed and rotation direction.

E. The VFD shall auto restart after a power failure.

F. For maintenance purposes, the VFD system shall be capable of starting, stopping, and running with stable operation with the motor completely disconnected (no load).

G. VFD shall include an integral locking disconnect.

H. VFD shall include an integral PI controller capable of closed loop control of motor speed based on external analog speed reference signals or programmed digital input signals.

2.4 FACTORY TEST, VARIABLE FREQUENCY DRIVE

A. Prior to shipping any equipment, the manufacturer shall individually test and certify each unit to document compliance. This certification report shall be submitted as part of the operation and maintenance manual and include the following minimum testing:

1. A visual inspection shall be made consisting of all system components, wiring connections, and safety mechanisms.
2. High pot testing shall be conducted on the completed VFD system including all accessory power components as a complete package. This test shall be conducted per UL 508C (two times the rated voltage plus 1000 volts AC for 60 seconds) using regularly calibrated high pot test equipment.
3. A system run test shall be conducted using an actual motor accelerated and decelerated through the entire speed range.
4. All control panel devices, including switches, pilot lamps, keypad and special control devices shall be functional tested.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Field start-up service shall be provided by an authorized factory representative. The supplier shall provide warranty and authorized factory services including field start-up and training. The following adjustments and tests shall be performed as a minimum with certified copies included in the operation and maintenance manual:

1. Verify that the input voltage is within the manufacturer's specification tolerances.
2. Verify that the motor rotation is correct in all modes of operation.
3. Verify all operator devices, programming, and monitoring functions to be fully operational.
5. Verify operation of all field signal control connections.
6. Measure and record system output voltage and current at 50% and 100% speed. Tune the output voltage to correspond to motor nameplate rating at full speed. Check full load current measurements against nameplate data.
7. Make all parameter adjustments to tune and optimize the VFD system to the application. Record all configuration values as part of this report.
8. Conduct harmonic tests as identified in this specification. Measurements shall be recorded for each unit with the VFD system off, running at 50% speed, and running at full speed and load.

B. Owner training shall be provided for each model and type of VFD system provided. Training shall consist of both classroom and actual equipment hands-on training.

C. Installation shall be in accordance with manufacturer's printed instructions.

D. The mechanical contractor shall coordinate the mounting location of the VFD with the electrical contractor to be certain that it is not mounted in the airstream of unfiltered exhaust air; i.e. in a parking garage application. If no location is feasible to meet this location criteria, the VFD may be mounted inside a NEMA 3R enclosure in the dirty air location.

3.2 SPARE PARTS

A. Furnish one spare main logic board, key pad, and power supply board. Furnish one set of spare parts for each unique VFD design supplied.

END OF SECTION 230810

SECTION 230900 – ELECTRONIC CONTROLS

PART 1 – GENERAL

1.1 TABLE OF RELATED DOCUMENTS

A. All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.

B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.

C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.

D. If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

1.2 DEFINITIONS

A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.

B. Binary: A two-state system where an “ON” condition is represented by one discrete signal level and an “OFF” condition is represented by a second discrete signal level.

C. Building Management System (BMS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BMS Contractor and to be interfaced to the associated work of other related trades.

D. BMS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BMS work.

E. Control Sequence: An BMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.

F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.

G. BMS Network: The total digital on-line real-time interconnected configuration of BMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.

H. Node: A digitally programmable entity existing on the BMS network.

I. BMS Integration: The complete functional and operational interconnection and interfacing of all BMS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BMS as required by this Division.

J. Provide: The term “Provide” and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.

K. PC: IBM-compatible Personal Computer from a recognized major manufacturer

L. Furnish: The term “Furnish” and its derivatives when used in this Division shall mean supply at the BMS Contractor’s cost to the designated third party trade contractor for installation. BMS Contractor shall connect furnished items to the BMS, calibrate, test, commission, warrant and document.

M. Wiring: The term “Wiring” and its derivatives when used in this Division shall mean provide the BMS wiring and terminations.

N. Install: The term “Install” and its derivatives when used in this Division shall mean receive at the jobsite and mount.

O. Protocol: The term “protocol” and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BMS network nodes.

P. Software: The term “software” and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BMS industry for real-time, on-line, integrated BMS configurations.

Q. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.

R. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.

S. The following abbreviations and acronyms may be used in describing the work of this Division:

ADC	-	Analog to Digital Converter
AI	-	Analog Input
AN	-	Application Node
ANSI	-	American National Standards Institute
AO	-	Analog Output
ASCII	-	American Standard Code for Information Interchange
ASHRAE		American Society of Heating, Refrigeration and Air Conditioning Engineers
AWG	-	American Wire Gauge
CPU	-	Central Processing Unit
CRT	-	Cathode Ray Tube
DAC	-	Digital to Analog Converter
DDC	-	Direct Digital Control
DI	-	Digital Input
DO	-	Digital Output
EEPROM	-	Electronically Erasable Programmable Read Only Memory

EMI	-	Electromagnetic Interference
FAS	-	Fire Alarm Detection and Annunciation System
GUI	-	Graphical User Interface
HOA	-	Hand-Off-Auto
ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center
NC	-	Normally Closed
NIC	-	Not In Contract
NO	-	Normally Open
OWS	-	Operator Workstation
OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
RTD	-	Resistance Temperature Device
SPDT	-	Single Pole Double Throw
SPST	-	Single Pole Single Throw
XVGA	-	Extended Video Graphics Adapter
TBA	-	To Be Advised
TCP/IP	-	Transmission Control Protocol/Internet Protocol
TTD	-	Thermistor Temperature Device
UPS	-	Uninterruptible Power Supply
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
VDC	-	Volts, Direct Current
WAN	-	Wide Area Network

1.3 BMS DESCRIPTION

A. The Building Management System shall be integrated in to the existing campus control system (Johnson Metasys).

B. The Building Management System (BMS) shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the FMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

C. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

D. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specifications together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.

E. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.

F. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

G. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

H. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:

1. Operator information, alarm management and control functions.
2. Enterprise-level information and control access.
3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
4. Diagnostic monitoring and reporting of BMS functions.
5. Offsite monitoring and management access.
6. Energy management
7. Standard applications for terminal HVAC systems.
8. [Indoor Air Quality monitoring and control]

I. BMS Controls Manufacturer Bid Form

BMS System Cost Breakdown: Contractor to fill out and provide cost for base bid and all alternates.
The General Contract bid will be tabulated using the Column "Base Bid" total along with all other Mechanical work. (All other Mechanical items not specifically listed on this form are to be bid as specified, as listed on the Drawings, or as approved in the Addendum to the contract documents.) Prices shall be as quoted to the Contractor by the vendor, exclude sales tax.
The selected General Contractor, will provide this form complete, to the Owner within two hours after the General Contractor selection. At that time, the Mechanical Contractor's bid must include all items in all columns listed on this form. Prices shall be verified by a copy of the quotation on request.
Vendors not specifically pre-listed under alternate Columns A, B, C, D, E or "F" on this form may be submitted as a substitute by the Contractor for consideration by the Owner following procedures noted in the specification. If a column does not have a vendor pre-listed and a substitute has been pre-approved, the Mechanical Contractor may indicate the vendor providing the price. Mechanical items not specifically listed on this form, in the Specification, on the Drawings or as approved in the Addendum to the contract documents, cannot be listed on the Mechanical Bid Breakdown.

The Owner is obligated to use items in Column "Base Bid". The Owner may elect to pick and choose from among alternative offerings in Columns A, B, C, D, E and "F" via change order. The contract shall be adjusted without markup for any price differential between the price listed in Column "Base Bid" and that listed in any selected alternative column. The Owner reserves the right to accept or reject any of the Equipment or System items anytime within ninety (90) days after signing a contract.

Specification Section	Base Bid	A Johnson Controls	B Atkinson Electronics	C Utah Yamas	D Delta Controls	E Trane Controls	F Harris Controls
230900	$	$	$	$	$	$	$

1.4 QUALITY ASSURANCE

A. General:

1. The Building Management System Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems.
2. The BMS Contractor shall be a recognized national manufacturer, installer and service provider of BMS.
3. The BMS Contractor shall have a branch facility within a 100-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.
4. As evidence and assurance of the contractor’s ability to support the Owner's system with service and parts, the contractor must have been in the BMS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
5. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems, and shall be the manufacturer’s latest standard of design at the time of bid.

B. Workplace Safety And Hazardous Materials:

1. Provide a safety program in compliance with the Contract Documents.
2. The FMS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The Contractor and its employees and subtrades comply with federal, state and local safety regulations.
4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA have jurisdiction for at least each topic listed in the Safety Certification Manual.
5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.

6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.

7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.

8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.

9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Designate a competent and experienced employee to provide BMS Project Management. The designated Project Manger shall be empowered to make technical, scheduling and related decisions on behalf of the BMS Contractor. At minimum, the Project Manager shall:
   a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
   b. Manage the financial aspects of the BMS Contract.
   c. Coordinate as necessary with other trades.
   d. Be responsible for the work and actions of the BMS workforce on site.

1.5 REFERENCES

A. All work shall conform to the following Codes and Standards, as applicable:

1. National Fire Protection Association (NFPA) Standards.
2. National Electric Code (NEC) and applicable local Electric Code.
3. Underwriters Laboratories (UL) listing and labels.
4. UL 864 UUKL Smoke Control
5. UL 268 Smoke Detectors.
6. UL 916 Energy Management
7. NFPA 70 - National Electrical Code.
8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
9. NFPA 92A and 92B Smoke Purge/Control Equipment.
10. Factory Mutual (FM).
11. American National Standards Institute (ANSI).
12. National Electric Manufacturer's Association (NEMA).
13. American Society of Mechanical Engineers (ASME).
14. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) [user note: add ASHRAE 62 IAQ as applicable].

15. Air Movement and Control Association (AMCA).
16. Institute of Electrical and Electronic Engineers (IEEE).
17. American Standard Code for Information Interchange (ASCII).
18. Electronics Industries Association (EIA).
19. Occupational Safety and Health Administration (OSHA).
20. American Society for Testing and Materials (ASTM).
21. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
22. Americans Disability Act (ADA)
23. ANSI/EIA 909.1-A-1999 (BACNET)
24 ANSI/ASHRAE Standard 195-2004 (BACnet)

B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.

C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.6 WORK BY OTHERS

A) The demarcation of work and responsibilities between the BMS Contractor and other related trades shall be as outlined in the BMS RESPONSIBILITY MATRIX

BMS RESPONSIBILITY MATRIX				
WORK	**FURNISH**	**INSTALL**	**Low Volt. WIRING/TUBE**	**LINE POWER**
BMS low voltage and communication wiring	BMS	BMS	BMS	N/A
BMS conduits and raceway	BMS	BMS	BMS	BMS
Automatic dampers	BMS	23	N/A	N/A
Manual valves	23	23	N/A	N/A
Automatic valves	BMS	23	BMS	N/A
Pipe insertion devices and taps including thermowells, flow and pressure stations.	BMS	23	BMS	BMS
BMS Current Switches.	BMS	BMS	BMS	N/A
BMS Control Relays	BMS	BMS	BMS	N/A
Power distribution system monitoring interfaces	26	26	BMS	26
Water Source Heat Pumps	23	23	23	23
All BMS Nodes, equipment, housings, enclosures and panels.	BMS	BMS	BMS	BMS
Smoke Detectors	26	26	26	26
Fire/Smoke Dampers	23	23	BMS	26
Fire Dampers	23	23	N/A	N/A
Boiler wiring	23	23	23	23
Water treatment system	23	23	23	26
VFDs	23	26	BMS	26
Fire Alarm shutdown relay interlock wiring	26	26	26	26
Fire Alarm smoke control relay interlock wiring	26	26	BMS	26
Fireman’s Smoke Control Override Panel	26	26	26	26
Cooling Tower Vibration Switches	23	23	26	26
Cooling Tower Level Control Devices	23	23	26	26
Cooling Tower makeup water control	23	23	26	26

devices				
Starters, HOA switches	26	26	N/A	26
Control damper actuators	BMS	BMS	BMS	26

1.7 SUBMITTALS

A. Shop Drawings, Product Data, and Samples:

1. The BMS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
3. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BMS work.
4. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
5. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
6. The BMS Contractor shall correct any errors or omissions noted in the first review.
7. At a minimum, submit the following:
   a. BMS network architecture diagrams including all nodes and interconnections.
   b. Systems schematics, sequences and flow diagrams.
   c. Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
   d. Samples of Graphic Display screen types and associated menus.
   e. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
   f. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
   g. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
   h. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address.
   i. Details of all BMS interfaces and connections to the work of other trades.
   j. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.8 RECORD DOCUMENTATION

A. Operation and Maintenance Manuals:

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BMS provided:
   a. Table of contents.
   b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
   c. Manufacturers product data sheets or catalog pages for all products including software.
   d. System Operator's manuals.
   e. Archive copy of all site-specific databases and sequences.
   f. BMS network diagrams.
   g. Interfaces to all third-party products and work by other trades.
2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

1.9 WARRANTY

A. Standard Material and Labor Warranty:
   1. Provide a one-year labor and material warranty on the BMS.
   2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BMS Contractor at the cost of the BMS Contractor.
   3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BMS Contractor's normal business hours.

PART 2 – PRODUCTS

2.1 LARGE GENERAL DESCRIPTION

A. The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

B. The Building Management System shall consist of the following:
   1. Standalone Network Engine(s)
   2. Equipment Controller(s)
   3. Input/Output Module(s)
   4. Local Display Device(s)
   5. Portable Operator's Terminal(s)

6. Distributed User Interface(s)
7. Network processing, data storage and communications equipment
8. Other components required for a complete and working BMS

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

2.2 BMS ARCHITECTURE

A. Automation Network:

1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard “off the shelf” products available through normal PC vendor channels.
2. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
3. Network Engines shall reside on the automation network.
4. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

B. Control Network:

1. Network Supervisor shall provide supervisory control over the control network and shall support the following communication protocol:
   a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9.
2. Control networks shall provide either “Peer-to-Peer,” Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
3. DDC Controllers shall reside on the control network.
4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
5. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
6. The Conformance Statements shall be submitted 10 day prior to bidding.

C. Integration:

1. BACnet Protocol Integration - BACnet
   a. The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2003.
   b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
   c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

2.3 USER INTERFACE

A. Distributed Web Based User Interface:

1. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.
2. The software shall run on the Microsoft Internet Explorer (6.0 or higher) browser.
3. Minimum hardware requirements:
   - ◊ 256 MB RAM
   - ◊ 2.0 GHz Clock Speed Pentium 4 Microprocessor.
   - ◊ 40.0 GB Hard Drive.
   - ◊ 1 Keyboard with 83 keys (minimum).
   - ◊ SVGA 1024x768 resolution display with 64K colors and 16 bit color depth.
   - ◊ Mouse or other pointing device

B. User Interface Application Components:

1. Operator Interface
   a. An integrated browser based client application shall be used as the user operator interface program.
   b. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.
   c. The user interface software shall provide help menus and instructions for each operation and/or application.
   d. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
   e. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
      - ◊ User access for selective information retrieval and control command execution
      - ◊ Monitoring and reporting
      - ◊ Alarm, non-normal, and return to normal condition annunciation
      - ◊ Selective operator override and other control actions
      - ◊ Information archiving, manipulation, formatting, display and reporting
      - ◊ FMS internal performance supervision and diagnostics
      - ◊ On-line access to user HELP menus
      - ◊ On-line access to current FMS as-built records and documentation
      - ◊ Means for the controlled re-programming, re-configuration of FMS operation and for the manipulation of FMS database information in compliance with the prevailing codes, approvals and regulations for individual FMS applications.
   f. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.

2. Navigation Trees
   a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
   b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
   c. The navigation trees shall be “dockable” to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.
3. Alarms
   a. Alarms shall be routed directly from Network Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
      ◊ Log date and time of alarm occurrence.
      ◊ Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
      ◊ Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
      ◊ Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
      ◊ Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
      ◊ Any attribute of any object in the system may be designated to report an alarm.
   b. The FMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions
   c. The FMS shall annunciate application alarms at minimum, as required by Part 3.
4. Reports and Summaries
   a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
      ◊ All points in the BMS
      ◊ All points in each BMS application
      ◊ All points in a specific controller
      ◊ All points in a user-defined group of points
      ◊ All points currently in alarm
      ◊ All points locked out
      ◊ All BMS schedules
      ◊ All user defined and adjustable variables, schedules, interlocks and the like.
   b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.

c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.

d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.

5. Schedules

a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:

◊ Weekly schedules
◊ Exception Schedules
◊ Monthly calendars.

b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.

c. It shall be possible to define one or more exception schedules for each schedule including references to calendars

d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.

e. Changes to schedules made from the User Interface shall directly modify the Network Engine schedule database.

f. Schedules and Calendars shall comply with ASHRAE SP135/2003 BACnet Standard.

g. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.

6. Password
   a. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
   b. Each user shall have the following: a user name (24 characters minimum), a password (12 characters minimum), and access levels.
   c. The system shall allow each user to change his or her password at will.
   d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
   e. A minimum of five levels of access shall be supported individually or in any combination as follows:
      ◊ Level 1 = View Data
      ◊ Level 2 = Command
      ◊ Level 3 = Operator Overrides
      ◊ Level 4 = Database Modification
      ◊ Level 5 = Database Configuration
      ◊ Level 6 = All privileges, including Password Add/Modify
   f. A minimum of 100 unique passwords shall be supported.
   g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
   h. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.
7. Screen Manager - The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.
8. Dynamic Color Graphics
   a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
   b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
   c. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
      ◊ All graphics shall be fully scalable
      ◊ The graphics shall support a maintained aspect ratio.
      ◊ Multiple fonts shall be supported.
      ◊ Unique background shall be assignable on a per graphic basis.
      ◊ The color of all animations and values on displays shall indicate if the status of the object attribute.

d. Operation from graphics – It shall be possible to change values (setpoints) and states in system controlled equipment by using drop-down windows accessible via the pointing device

e. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.

◊ The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.

◊ In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP or JPG file formats.

f. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.

9. Historical trending and data collection

a. The Building Management System shall store trend and point history data for all analog and digital inputs and outputs, as follows:

◊ Any point, physical or calculated, may be designated for trending. Three methods of collection shall be allowed:
Defined time interval
Upon a change of value

◊ Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

10. Trend data viewing and analysis

a. Provide a trend viewing utility that shall have access to all database points.

b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.

c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends

d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.

e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.

f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.

g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.

2.4 NETWORK ENGINES/SUPERVISOR

A. Network Engine/Servers

1. The Network Engine shall be a fully user-programmable, supervisory controller. The Network Engine shall monitor the network of distributed application-specific

controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Engines.

2. Automation network – The Network Supervisor shall reside on the automation network and shall support a subnet of system controllers.

3. User Interface – Each Network Supervisor shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
   a. The web based UI software shall be imbedded in the Network Supervisor. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
   b. The Network Supervisor shall support up a minimum of four (4) concurrent users.
   c. The web based user shall have the capability to access all system data through one Network Supervisor.
   d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one Network Supervisor.
   e. Systems that require the user to address more than one Network Supervisor to access all system information are not acceptable.
   f. The Network Supervisor shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the Network Supervisor.
   g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
   h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
      ◊ Configuration
      ◊ Commissioning
      ◊ Data Archiving
      ◊ Monitoring
      ◊ Commanding
      ◊ System Diagnostics
   i. Systems that require workstation software or modified web browsers are not acceptable.
   j. The Network Supervisor shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

4. Processor – The Network Supervisor shall be microprocessor-based with a minimum word size of 32 bits. The Network Supervisor shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. Network Supervisor size and capability shall be sufficient to fully meet the requirements of this Specification.

5. Memory – Each Network Supervisor shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

6. Hardware Real Time Clock – The Network Supervisor shall include an integrated, hardware-based, real-time clock.

7. The Network Supervisor shall include troubleshooting LED indicators to identify the following conditions:
   a. Power - On/Off

b. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
c. Ethernet Connection Speed – 10 Mbps/100 Mbps
d. FC Bus A – Normal Communications/No Field Communications
e. FC Bus B – Normal Communications/No Field Communications
f. Peer Communication – Data Traffic Between Network Supervisor Devices
g. Run – Network Supervisor Running/ Network Supervisor In Startup/ Network Supervisor Shutting Down/Software Not Running
h. Bat Fault – Battery Defective, Data Protection Battery Not Installed
i. 24 VAC – 24 VAC Present/Loss Of 24VAC
j. Fault – General Fault
k. Modem RX – Network Supervisor Modem Receiving Data
l. Modem TX – Network Supervisor Modem Transmitting Data

8. Communications Ports – The Network Supervisor shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.
   a. Two (2) USB port
   b. Two (2) URS-232 serial data communication port
   c. Two (2) RS-485 port
   d. One (1) Ethernet port
9. Diagnostics – The Network Supervisor shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Supervisor shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
10. Power Failure – In the event of the loss of normal power, The Network Supervisor shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
   a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
   b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
11. Certification – The Network Supervisor shall be listed by Underwriters Laboratories (UL).
12. Controller network – The Network Supervisor shall support the following communication protocols on the controller network:
   a. The Network Supervisor shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
      ◊ A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
      ◊ The Conformance Statements shall be submitted 10 day prior to bidding.
      ◊ The Network Supervisor shall support a minimum of 100 control devices.
   b. The Network Supervisor shall support BACNET enabled devices using the Free Topology Transceiver FTT10.
      ◊ All BACNET controls devices shall be BACNET certified.

◊ The Network Supervisor shall support a minimum of 255 BACNET enabled control devices.

c. The Building Management System shall be able to integrate the Johnson Controls N2 Field Bus.

◊ The Network Supervisor shall support a minimum of 100 N2 control devices.

◊ The Bus shall conform to Electronic Industry Alliance (EIA) Standard RS-485.

◊ The Bus shall employ a master/slave protocol where the Network Supervisor is the master.

◊ The Bus shall employ a four (4) level priority system for polling frequency.

◊ The Bus shall be optically isolated from the Network Supervisor.

2.5 DDC SYSTEM CONTROLLERS

A. Field Equipment Controller:

1. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
2. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
3. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
4. The FEC shall include a removable base to allow pre-wiring without the controller.
5. The FEC shall include troubleshooting LED indicators to identify the following conditions:
   a. Power On
   b. Power Off
   c. Download or Startup in progress, not ready for normal operation
   d. No Faults
   e. Device Fault
   f. Field Controller Bus - Normal Data Transmission
   g. Field Controller Bus - No Data Transmission
   h. Field Controller Bus - No Communication
   i. Sensor-Actuator Bus - Normal Data Transmission
   j. Sensor-Actuator Bus - No Data Transmission
   k. Sensor-Actuator Bus - No Communication
6. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
7. The FEC shall support the following types of inputs and outputs:
   a. Universal Inputs - shall be configured to monitor any of the following:
      ◊ Analog Input, Voltage Mode
      ◊ Analog Input, Current Mode
      ◊ Analog Input, Resistive Mode
      ◊ Binary Input, Dry Contact Maintained Mode
      ◊ Binary Input, Pulse Counter Mode
   b. Binary Inputs - shall be configured to monitor either of the following:
      ◊ Dry Contact Maintained Mode
      ◊ Pulse Counter Mode

c. Analog Outputs - shall be configured to output either of the following
   ◊ Analog Output, Voltage Mode
   ◊ Analog Output, current Mode
d. Binary Outputs - shall output the following:
   ◊ 24 VAC Triac
e. Configurable Outputs - shall be capable of the following:
   ◊ Analog Output, Voltage Mode
   ◊ Binary Output Mode

8. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).
   a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
   b. The FC Bus shall support communications between the FECs and the Network Supervisor.
   c. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the Network Supervisor.
   d. The FC Bus shall support a minimum of 100 IOMs and FEC in any combination.
   e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.
   f.
9. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
   a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
   b. The SA Bus shall support a minimum of 10 devices per trunk.
   c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.
10. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
11. The FEC shall support, but not be limited to, the following:
   a. Hot water, chilled water/central plant applications
   b. Built-up air handling units for special applications
   C. Terminal units
   c. Special programs as required for systems control

2.6 FIELD DEVICES

A. Input/Output Module:

1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
2. The IOM shall communicate with the FEC over either the FC Bus or the SA Bus using BACnet Standard protocol SSPC-135, Clause 9.
3. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
4. The IOM shall have a minimum of 4 points to a maximum of 17 points.

5. The IOM shall support the following types of inputs and outputs:
   a. Universal Inputs - shall be configured to monitor any of the following:
      ◊ Analog Input, Voltage Mode
      ◊ Analog Input, Current Mode
      ◊ Analog Input, Resistive Mode
      ◊ Binary Input, Dry Contact Maintained Mode
      ◊ Binary Input, Pulse Counter Mode
   b. Binary Inputs - shall be configured to monitor either of the following:
      ◊ Dry Contact Maintained Mode
      ◊ Pulse Counter Mode
   c. Analog Outputs - shall be configured to output either of the following
      ◊ Analog Output, Voltage Mode
      ◊ Analog Output, current Mode
   d. Binary Outputs - shall output the following:
      ◊ 24 VAC Triac
   e. Configurable Outputs - shall be capable of the following:
      ◊ Analog Output, Voltage Mode
      ◊ Binary Output Mode
6. The IOM shall include troubleshooting LED indicators to identify the following conditions:
   a. Power On
   b. Power Off
   c. Download or Startup in progress, not ready for normal operation
   d. No Faults
   e. Device Fault
   f. Normal Data Transmission
   g. No Data Transmission
   h. No Communication

B. Networked Thermostat:
   1. The Networked Thermostat shall be capable of controlling a heat pump system with single-speed fan control.
   2. The Networked Thermostat shall communicate over the Field Controller Bus using BACnet Standard protocol SSPC-135, Clause 9.
      a. The Networked Thermostat shall support remote read/write and parameter adjustment from the web based User Interfaceable through a Network Engine.
   3. The Networked Thermostat shall include an intuitive User Interface providing plain text messages.
      a. Two line, 8 character backlit display
      b. LED indicators for Fan, Heat, and Cool status
      c. Five (5) User Interface Keys
         ◊ Mode
         ◊ Fan
         ◊ Override
         ◊ Degrees C/F
         ◊ Up/Down
      d. The display shall continuously scroll through the following parameters:
         ◊ Room Temperature
         ◊ System Mode
         ◊ Schedule Status – Occupied/Unoccupied/Override

◊ Applicable Alarms

4. The Networked Thermostat shall provide the flexibility to support any one of the following inputs:
   a. Integral Indoor Air Temperature Sensor
   b. Duct Mount Air Temperature Sensor
   c. Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator.
   d. Two configurable binary inputs
5. The Networked Thermostat shall provide the flexibility to support any one of the following outputs:
   a. Three Speed Fan Control
   b. Two On/Off
   c. Two Floating
   d. Two Proportional (0 to 10V)
6. The Networked Thermostat shall provide a minimum of six (6) levels of keypad lockout.
7. The Networked Thermostat shall provide the flexibility to adjust the following parameters:
   a. Adjustable Temporary Occupancy from 0 to 24 hours
   b. Adjustable heating/cooling deadband from 2º F to 5º F
   c. Adjustable heating/cooling cycles per hour from 4 to 8
8. The Networked Thermostat shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.

C. Network Sensors

1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
   a. Zone Temperature
   b. Zone humidity
   c. Zone setpoint
2. The NS shall transmit the zone information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
3. The Network Sensors shall include the following items:
   a. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint.
   b. An LED to indicate the status of the Override feature.
   c. A button to toggle the temperature display between Fahrenheit and Celsius.
   d. A button to initiate a timed override command
4. The NS shall be available with either screw terminals or phone jack.
5. The NS shall be available in either surface mount or wall mount styles.

D. System Configuration Tool **(SCT)**

1. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a Network Engine.
2. The configuration tool shall provide an archive database for the configuration and application data.
3. The configuration tool shall have the same look-and-feel at the User Interface (UI) regardless of whether the configuration is being done online or offline.

4. The configuration tool shall include the following features:
   a. Basic system navigation tree for connected networks
   b. Integration of BACNET, and BACnet enabled devices
   c. Customized user navigation trees
   d. Point naming operating parameter setting
   e. Graphic diagram configuration
   f. Alarm and event message routing
   g. Graphical logic connector tool for custom programming
   h. Downloading, uploading, and archiving databases
5. The configuration tool shall have the capability to automatically discover field devices on connected buses and networks. Automatic discovery shall be available for the following field devices:
   a. BACnet Devices
   b. BACNET devices
6. The configuration tool shall be capable of programming the Field Equipment Controllers.
   a. The configuration tool shall provide the capability to configure, simulate, and commission the Field Equipment Controllers.
   b. The configuration tool shall allow the FECs to be run in Simulation Mode to verify the applications.
   c. The configuration tool shall contain a library of standard applications to be used for configuration.
7. The configuration tool shall be capable of programming the field devices.
   a. The configuration tool shall provide the capability to configure, simulate, and commission the field devices.
   b. The configuration tool shall allow the field devices to be run in Simulation Mode to verify the applications.
   c. The configuration tool shall contain a library of standard applications to be used for configuration
8. A wireless access point shall allow a wireless enabled portable PC to make a temporary Ethernet connection to the automation network.
   a. The wireless connection shall allow the PC to access configuration tool through the web browser using the User Interface (UI).
   b. The wireless use of configuration tool shall be the same as a wired connection in every respect.
   c. The wireless connection shall use the Bluetooth Wireless Technology.

E. Wireless MS/TP Converter
   a. The converter shall provide a temporary wireless connection between the SA or FC Bus and a wireless enabled portable PC.
   b. The converter shall support downloading and troubleshooting FEC and field devices from the PC over the wireless connection.
   c. The converter shall employ Bluetooth Wireless Technology.
   d. The converter shall be powered through a connection to either the Sensor-Actuator (SA) or the Field Controller (FC) Bus.
   e. The converter shall operate over a minimum of thirty three (33) feet within a building.
   f. The converter shall have LED indicators to provide information regarding the following conditions:
      ◊ Power - On/Off
      ◊ Fault – Fault/No Fault

◊ SA/FC Bus – Bus Activity/ No Bus Activity
◊ Blue – Bluetooth Communication Established/ Bluetooth Communication Not Established

g. The device shall comply with FCC Part 15.247 regulations for low-power unlicensed transmitters.

2.7 INPUT DEVICES

A. General Requirements

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors

1. General Requirements:
   a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
   b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
   c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	**Accuracy**
Chilled Water	± .5°F.
Room Temp	± .5°F.
Duct Temperature	± .5°F.
All Others	± .75°F.

2. Room Temperature Sensors
   a. Room sensors shall be constructed for either surface or wall box mounting.
   b. Room sensors shall have the following options when specified:
      ◊ Setpoint reset slide switch providing a ±3 degree (adjustable) range.
      ◊ Individual heating/cooling setpoint slide switches.
      ◊ A momentary override request push button for activation of after-hours operation.
      ◊ Analog thermometer.
3. Room Temperature Sensors with Integral Display
   a. Room sensors shall be constructed for either surface or wall box mounting.
   b. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:
      ◊ Display room and outside air temperatures.
      ◊ Display and adjust room comfort setpoint.
      ◊ Display and adjust fan operation status.
      ◊ Timed override request push button with LED status for activation of after-hours operation.
      ◊ Display controller mode.
      ◊ Password selectable adjustment of setpoint and override modes.
4. Thermo wells
   a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.

b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
c. Thermo wells and sensors shall be mounted in a threadolet or 1/2” NFT saddle and allow easy access to the sensor for repair or replacement.
d. Thermo wells shall be constructed of 316 stainless steel.

5. Outside Air Sensors
   a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
   b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
   c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
6. Duct Mount Sensors
   a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
   b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
   c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
7. Averaging Sensors
   a. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
   b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
   c. Capillary supports at the sides of the duct shall be provided to support the sensing string.
8. Acceptable Manufacturers: Johnson Controls, Setra, or approved equal.

C. Humidity Sensors
1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

7. Acceptable Manufacturers: Johnson Controls, Veris Industries, and Mamac, or approved equal.

D. Differential Pressure Transmitters

1. General Air and Water Pressure Transmitter Requirements:
   a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
   b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
   c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
   d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
2. Low Differential Water Pressure Applications (0” - 20” w.c.)
   a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
   b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
      ◊ .01-20” w.c. input differential pressure range.
      ◊ 4-20 mA output.
      ◊ Maintain accuracy up to 20 to 1 ratio turndown.
      ◊ Reference Accuracy: +0.2% of full span.
   c. Acceptable Manufacturers: Setra and Mamac, or approved equal.
3. Medium to High Differential Water Pressure Applications (Over 21” w.c.)
   a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
      ◊ Differential pressure range 10” w.c. to 300 PSI.
      ◊ Reference Accuracy: ±1% of full span (includes non-linearity, hysteresis, and repeatability).
   b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
   c. Acceptable Manufacturers: Setra and Mamac, or approved equal.
4. Building Differential Air Pressure Applications (-0.1” w.c. to +0.1” w.c.)
   a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
   b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
      ◊ -0.1” w.c. to +0.1” w.c. input differential pressure ranges. (Select range appropriate for system application)
      ◊ 4-20 mA output.
      ◊ Maintain accuracy up to 20 to 1 ratio turndown.

◊ Reference Accuracy: +0.2% of full span.

c. Acceptable Manufacturers: AutoTran #750D.

5. Low Differential Air Pressure Applications (0” to 5” w.c.)

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.

b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

◊ (0.00 - 1.00” to 5.00”) w.c. input differential pressure ranges. (Select range appropriate for system application.)

◊ 4-20 mA output.

◊ Maintain accuracy up to 20 to 1 ratio turndown.

◊ Reference Accuracy: +0.2% of full span.

c. Acceptable Manufacturers: Johnson Controls and Setra, or approved equal.

6. Medium Differential Air Pressure Applications (5” to 21” w.c.)

a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:

◊ Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.

◊ Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.

◊ Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).

b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

c. Acceptable manufacturers: Johnson Controls and Setra, or approved equal.

E. Flow Monitoring

1. Water Flow Monitoring

◊ Water flow meters shall be electromagnetic type with integral microprocessor-Based electronics. The meter shall have an accuracy of 0.25%.

◊ Acceptable manufacturers: Onicon, or approved equal.

F. Power Monitoring Devices

1. Current Measurement (Amps)

a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.

b. Current Transformer – A split core current transformer shall be provided to monitor motor amps.

◊ Operating frequency – 50 - 400 Hz.

◊ Insulation – 0.6 Kv class 10Kv BIL.

◊ UL recognized.

◊ Five amp secondary.

◊ Select current ration as appropriate for application.
◊ Acceptable manufacturers: Veris Industries, or approved equal.

c. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
   ◊ 6X input over amp rating for AC inrushes of up to 120 amps.
   ◊ Manufactured to UL 1244.
   ◊ Accuracy: +.5%, Ripple +1%.
   ◊ Minimum load resistance 30kOhm.
   ◊ Input 0-20 Amps.
   ◊ Output 4-20 mA.
   ◊ Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).
   ◊ Acceptable manufacturers: Veris Industries, or approved equal.

G. Refrigerant Leak Detectors

1. The refrigerant leak detector shall be a standalone device and shall provide a SPDT output to directly energize the refrigeration room exhaust ventilation fans. The detector shall include a sensor or sensors connected to a control panel. Two relay contacts at the control panel shall provide trouble and alarm indication to the Facility Management System. The alarm relay contact shall also directly energize the exhaust fans.

2. The refrigerant leak detector shall sense the type of refrigerant used in the specified chillers. Multiple sensors shall be required to detect different refrigerants and/or provide proper sensing coverage for the area of the refrigeration room.

3. Acceptable manufacturers: Johnson Controls, MSA Instruments, or approved equal.

H. Smoke Detectors

1. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 26 for installation under Division 23. All wiring for air duct detectors shall be provided under Division 26, Fire Alarm System.

I. Status and Safety Switches

1. General Requirements

   a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

2. Current Sensing Switches

   a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
   b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
   c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
   d. Acceptable manufacturers: Veris Industries, or approved equal.

3. Air Filter Status Switches
   a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
   b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
   c. Provide appropriate scale range and differential adjustment for intended service.
   d. Acceptable manufacturers: Johnson Controls, Cleveland Controls, or approved equal.

4. Air Flow Switches
   a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
   b. Acceptable manufacturers: Johnson Controls, Cleveland Controls, or approved equal.
5. Air Pressure Safety Switches
   a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
   b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
   c. Acceptable manufacturers: Johnson Controls, Cleveland Controls, or approved equal.
6. Water Flow Switches
   a. Water flow switches shall be equal to the Johnson Controls P74, or approved equal.
7. Low Temperature Limit Switches
   a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
   b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
   c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
   d. The low temperature limit switch shall be equal to Johnson Controls A70, or approved equal.

2.8 OUTPUT DEVICES

A. Actuators
   1. General Requirements
      a. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.
   2. Electronic Damper Actuators
      a. Electronic damper actuators shall be direct shaft mount.
      b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer’s recommendations for face velocity, differential pressure and

damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.

c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as “quick acting,” shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.

e. Acceptable manufacturers: Johnson Controls, Mamac, or approved equal.

3. Electronic Valve Actuators

a. Electronic valve actuators shall be manufactured by the valve manufacturer.

b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.

c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized Based on valve manufacturer’s recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

f. Acceptable manufacturers: Johnson Controls, or approved equal.

B. Control Dampers

1. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawings.
2. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
3. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
4. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60”. Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48”x48” size shall not leak in excess of 8.0 cfm per square foot when closed against 4” w.g. static pressure when tested in accordance with AMCA Std. 500.
5. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5” w.g., but no more than 4000 FPM or 6” w.g. Acceptable manufacturers are Johnson Controls D-7250 D-1250 or D-1300, Ruskin CD50, and Vent Products 5650, or approved equal..
6. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below. Acceptable manufacturers are: Johnson Controls D-1600, Ruskin CD36, and Vent Products 5800, or approved equal..
7. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

C. Control Relays

1. Control Pilot Relays
   a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
   b. Mounting Bases shall be snap-mount.
   c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
   d. Contacts shall be rated for 10 amps at 120VAC.
   e. Relays shall have an integral indicator light and check button.
   f. Acceptable manufacturers: Johnson Controls, Lectro, or approved equal.
2. Lighting Control Relays
   a. Lighting control relays shall be latching with integral status contacts.
   b. Contacts shall be rated for 20 amps at 277 VAC.
   c. The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
   d. Lighting control relays shall be controlled by:
      ◊ Pulsed Tri-state Output – Preferred method.
      ◊ Pulsed Paired Binary Outputs.

◊ A Binary Input to the Facility Management System shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the “dry-contact” type.

e. The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state. Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

D. Control Valves

1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.

2. Chilled water control valves shall be modulating plug, ball as required by the specific application. Modulating water valves shall be sized per manufacturer’s recommendations for the given application. In general, valves (2 or 3-way) serving **variable** flow air handling unit coils shall be sized for a pressure drop equal to between 3 to 5 PSI. Valves (3-way) serving **constant** flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop accounting for piping geometry. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop accounting for piping geometry. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.

3. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.

4. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.

5. Ball valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way ball valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. 3-way valves for modulating service shall be sized to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.

6. Acceptable manufacturers: Johnson Controls, or approved equal.

E. Electronic Signal Isolation Transducers

1. A signal isolation transducer shall be provided whenever an analog output signal from the BMS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.

2. The signal isolation transducer shall provide ground plane isolation between systems.

3. Signals shall provide optical isolation between systems.

4. Acceptable manufacturers: Advanced Control Technologies, or approved equal.

F. External Manual Override Stations

1. External manual override stations shall provide the following:
   a. An integral HAND/OFF/AUTO switch shall override the controlled device pilot relay.
   b. A status input to the Facility Management System shall indicate whenever the switch is not in the automatic position.
   c. A Status LED shall illuminate whenever the output is ON.
   d. An Override LED shall illuminate whenever the HOA switch is in either the HAND or OFF position.
   e. Contacts shall be rated for a minimum of 1 amp at 24 VAC.

2.9 MISCELLANEOUS DEVICES

A. Local Control Panels

1. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

B. Power Supplies

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.
4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.

C. Thermostats

1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

PART 3 – PERFORMANCE / EXECUTION

3.1 BMS SPECIFIC REQUIREMENTS

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection. .

B. Custom Reports:

1. Provide custom reports as required for this project:

3.2 INSTALLATION PRACTICES

A. BMS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.
2. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
   a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
   b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.

6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BMS Line Voltage Power Source

1. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 16.
2. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

C. BMS Raceway

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2”.
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

D. Penetrations

1. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.
2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

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E. BMS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.

   Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

F. BMS Panel Installation

1. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer’s recommendations.
2. The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation

2. Locate components of the BMS in accessible local control panels wherever possible.

H. HVAC Input Devices – Genera1

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BMS in accessible local control panels wherever possible.
3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Outside Air Sensors
   a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
   b. Sensors shall be installed with a rain proof, perforated cover.
6. Water Differential Pressure Sensors
   a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
   b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
   c. The transmitters shall be installed in an accessible location wherever possible.
7. Medium to High Differential Water Pressure Applications (Over 21” w.c.):
   a. Air bleed units, bypass valves and compression fittings shall be provided.
8. Building Differential Air Pressure Applications (-1” to +1” w.c.):
   a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
   b. The interior tip shall be inconspicuous and located as shown on the drawings.
9. Duct Temperature Sensors:
   a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
   b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
   c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
   d. The sensor shall be mounted to suitable supports using factory approved element holders.
10. Space Sensors:
    a. Shall be mounted per ADA requirements.
    b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
11. Low Temperature Limit Switches:
    a. Install on the discharge side of the first water or steam coil in the air stream.
    b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.

c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.

12. Air Differential Pressure Status Switches:

a. Install with static pressure tips, tubing, fittings, and air filter.

13. Water Differential Pressure Status Switches:

a. Install with shut off valves for isolation.

I. HVAC Output Devices

1. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.

2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.

3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.

4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs.

5. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.3 TRAINING

A. The BMS contractor shall provide the following training services independent of training for any other separate building in project:

1. 16-hours of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

2. 80-hours of off-site training at equipment factory. Contractor to include all Fees, airfare, travel costs, hotel costs, etc., no additional costs to Owner.

3.4 COMMISSIONING

A. Fully commission all aspects of the Building Management System work.

B. Acceptance Check Sheet

1. Prepare a check sheet that includes all points for all functions of the BMS as indicated on the point list included in this specification.

2. Submit the check sheet to the Engineer for approval

3. The Engineer will use the check sheet as the basis for acceptance with the BMS Contractor.

C. VAV box performance verification and documentation:

1. The BMS Contractor shall test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.

2. The BMS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance.

D. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

3.5 VFD CONTROL

A. VFD to be controllable and programmable/adjustable through the BMS system.

3.6 BOILER CONTROL

A. Boiler to be controllable and programmable/adjustable through the BMS system.

3.7 SEQUENCES

A. See Drawings.

END OF SECTION 230900

SECTION 231123 - NATURAL GAS SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Fittings.

B. Gas Meter.

C. Gas Pressure Regulator.

D. Gas Safety Valve (Kitchen).

E. Flexible Connectors and Quick Couplers.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 230529- Basic Mechanical Materials and Methods: Valves, pipe hangers, supports and accessories.

B. Section 230548 - Mechanical Seismic Control.

C. Section 224450 - Plumbing Equipment: Gas supply and runout with gas cock or valve to water heater connection points.

D. Section 224460 - Special Plumbing Equipment Systems: Gas supply and runout with gas cock or valve to connection points on all kitchen and laboratory equipment, headers or modules.

E. Section 235200 - Boilers: Gas supply and runout with gas cock or valve to boiler connection points.

F. Section 235400 - Fuel Fired Heaters: Gas supply and runout with drip leg and gas cock or valve to heater connection points.

G. Section 237400 – Air Handling Systems on Roof: Gas supply and runout with drip leg and gas cock or valve to rooftop packaged air handler connection points.

1.4 REFERENCES

A. NFPA 54 (ANSI Z223.1) - National Fuel Gas Code.

B. ANSI Z223.1a - Supplement to National Fuel Gas Code.

1.5 DEFINITIONS

A. The following are references with definition acronyms used in this section:

1. U.L. - Underwriters Laboratory Listed for Fire Protection Systems.
2. F.M. - Factory Mutual Engineering Division.
3. IRI - Industrial Risk Insurors AKA: F.I.A. Factory Insurance Association.
4. Jurisdictional Agencies:

a. Building Department.
b. Fire Department or Fire Prevention Bureau or Marshal.
c. Insurance Agency, Carrier, and/or Underwriter.
d. Engineer refers to the consulting Mechanical Engineer of record.

1.6 SYSTEM DESCRIPTION

A. Provide gas supply from gas meter outlet to all gas consuming equipment complete with piping, meters, valves, unions, dirt legs, hangers, supports, anchors, expansion compensators and regulators.

1.7 QUALITY ASSURANCE

A. Welding: Welders shall be certified in accordance with requirements in Section 230529.

1.8 REGULATORY REQUIREMENTS

A. Conform to Regulatory Requirements listed in Section 230500.

1.9 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Pipe, fittings, valves, hangers and supports.
2. Regulators.
3. Meters.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Regulators.
2. Meters.
3. Valves.
4. Quick Couplers.

C. Submit certified test reports, dated and signed by authorized person showing compliance of tests of the fuel gas systems, in accordance with the Contract Documents.

1.10 SEQUENCING/SCHEDULING

A. Coordinate all work with all other trades and utility companies for elimination of interference, utilization of combined hanger support systems, timely routing and installation of systems, verifications of existing connector utilities, locations, depths, connection regulation, proper valving and junction structures or fittings. Location of meters, and remote readers as applicable and appropriate.

1.11 WARRANTIES

A. Provide original copies of all warranties for specific equipment where specified and in accordance with Section 230500.

B. Provide 20 year full warranty on all cathodic protection and pipe wrapping against corrosion of piping due to electrolytic or active soil conditions.

1.12 GAS SERVICE

A. Arrange with Civil Engineer/Contractor to provide gas service to indicated location with shut-off at terminus.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Buried Exterior to Gas Barbeque:

1. Pipe: As defined below:

a. Natural Gas:

1) High Density Polyethylene pipe and fittings; ASTM D-3350:335434C, PPI:PE 3408/3406, Type III, Grade P34 Category 5 per ASTM D 1248, SDR 11 pipe.

2) Polyvinylchloride natural gas pipe and fittings:

Size 1/2" thru 1-1/2": Sch. 40 Type 1 PVC 1120, IAPMO: 15-10-71, ASTM D 1785.

Size 2" thru 6": Class 315 Type 1 PVC 1120, IAPMO: 15-10-71, ASTM D 2513.

B. Interior Exposed or Accessible:

1. Size 1/2" thru 1-1/2":

Pipe: Schedule 40, ASTM A 53
Fittings: Threaded malleable iron
Joint Seal: Teflon
Unions: Black malleable iron ground joint, bronze to iron seat, 150 lb. class, ANSI B2.1 and ASTM A 197.

2. Size 2" and over:

Pipe: Schedule 40, ASTM A53, Type S Grade B
Fittings: Butt weld ASTM A 234
Unions: 150 lb. forged steel weld neck flange, ANSI B16.5 and ASTM A105.

C. Interior, concealed, non-accessible spaces and return air plenums:

Use no unions, tubing fittings, right or left couplings, bushing, shut-off valves, compression coupling, or swing joints made by combinations of fittings.

2.2 GAS METER

A. As provided by utility company.

2.3 GAS PRESSURE REGULATOR

A. General: Provide single stage, steel jacketed, corrosion-resistant gas pressure regulators with atmospheric vent, elevation compensator; with threaded ends for 2" and smaller, flanged ends for 2-1/2" and larger; for inlet and outlet gas pressures, specific gravity, and volume flow required.

B. Provide vent-limited or vented gas pressure regulators as required by appliance served. Vented regulators shall be piped to vent to outdoors per jurisdictional requirements.

2.4 GAS SAFETY VALVE (KITCHEN)

A. Manufacturer:

1. Automatic Switch Co. (ASCO) Series 8044 valves.

B. Operation Requirement:

1. Operating differential: 0 psi.
2. 120 volt, 60 hertz, 1 phase.
3. Coil insulation Class F.
4. Coil watt rating: 16.7 watts, all sizes.
5. Latched open when energized, free handle design, manual reset, and visual position indicator.

C. Control shall be as described in Part 3 – Execution of this Section.

2.5 VALVE CABINET (FOR GSV SOLENOID VALVES)

A. Manufacturer:

1. Croker Model 9100 modified for 8” depth.

B. Cabinet:

1. #4 stainless steel finish, surface mounted, Style K stainless steel door with cylinder lock and keys each cabinet, all cabinet keyed alike.
2. Provide SETON #EB312H sign, black “gothic standard” ¾” high lettering on 3” x 12” yellow background, self stick indexed “Manual Reset Gas Valve” and centered both ways on cabinet door.

PART 3 - EXECUTION

3.1 GENERAL

A. Welding, wiring, sleeves, plates and closures, foundations and pads, excavation and backfill, cutting and patching and installation of piping, valves, pipe hangers, supports, expansion compensators and identification shall be in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Provide all fuel gas piping from source to each connection point of all gas fired equipment items listed in "Related Work" paragraph in Part 1. Provide drip leg and gas cock or valve for each equipment item. Make final connections in compliance with equipment manufacturer's instructions. Flexible connections will not be allowed except where explicitly specified.

3.2 PIPING

A. General:

3. Install fuel gas distribution piping in accordance with jurisdiction codes and local Utility Company requirements and in conformity with standards listed in "References" paragraph in Part 1.
4. Install "Tee" fitting with bottom outlet fitted with full size 6" long nipple and capped, at bottom of pipe risers or drops.
5. Use dielectric unions where dissimilar metals are joined together.
6. Use Teflon joint seal on metal gas piping threads, make up with 3 threads showing.
7. Remove cutting and threading burrs before assembling piping.
8. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged.
9. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping, or equipment connections are completed.
10. Connections to all gas-fired equipment shall include a union downstream of the manual gas shut-off valve.
11. For buried piping outside of building walls, piping shall rise out of ground 12” before penetrating building wall.

12. Provide exterior gas piping and fittings with primed and painted surface. Coordinate color with Owner, Architect, and authority having jurisdiction.

B. Buried Piping: Left exposed until testing has been accepted. Bury 24" below grade minimum.

C. Buried Pipe Identification: Install bright colored continuously printed plastic ribbon tape of not less than 6 inches width and 4 mil thickness 6 to 8 inches below finished grade directly over buried pipe. Provide metalized tape over non-metallic pipe.

D. Interior Concealed Piping: All pipe and fittings shall be welded. Do not install valves of any type in air plenums or concealed spaces.

3.3 HANGERS AND SUPPORT SYSTEMS (Interior)

A. Provide pipe hangers, supports and accessories in accordance with Section 230529 - Basic Mechanical Materials and Methods.

3.4 ROOF SUPPORTS AND ANCHORS

A. Provide Miro brand pipe supports spaced per Hanger Specifications in Section 230529 - Basic Mechanical Materials and Methods. Provide pipe straps to anchor pipe to supports.

B. Provide pipe expansion loops as shown and required to eliminate pipe stress due to thermal expansion imposed by solar influence.

C. See details on Drawings.

3.5 VALVES

A. Provide valves in accordance with Section 230529 - Basic Mechanical Materials and Methods.

3.6 GAS SOLENOID VALVES

E. General:

1. Valves shall be mounted with solenoid valve stem in the vertical upright position only.
2. Valves shall be installed in wall boxes unless specifically defined to be in exposed location by the Contract Documents.
3. Valves shall be installed with unions, or other means to provide removal or repair without disassembly of connecting piping or of cabinet.
4. Provide electric wiring in accordance with Section 230529 Basic Mechanical Materials and Methods.
5. Provide neoprene grommets for all piping and electrical conduit entering and exiting cabinets.

F. GSV Valves:

1. Control panels and wall cabinets mounted 5’-0” from floor to centerline.

2. Provide necessary interlocks, relays, wiring and installation for valve operation in conjunction with fire suppression systems as follows:

   a. Valve shall be de-energized when fire suppression system is activated.
   b. Reset of valve only possible after the fire suppression system has been reset, recharged and in “ready” mode.

3.7 GAS COCKS AND GAS VALVES

A. Provide at supply runout connection for each gas-fired equipment item; and on risers and branches where indicated.

B. Locate gas cocks and valves where easily accessible, and where they will be protected from possible damage.

3.8 GAS SERVICE

A. Complete arrangements with Civil Engineer/Contractor to provide gas service to indicated location with shut-off at terminus.

B. Provide shut-off in gas service pipe at entry in building, extend pipe to gas meter location indicated; provide parts and accessories required by Utility to connect meter.

3.9 GAS METER

A. Be responsible to verify with utility company the size and thickness, reinforcing and location of all concrete pads, chain link enclosures, gate requirements, bar-hasp-padlock requirements, and size and type of traffic bollards-guards required.

B. Provide concrete pad in accordance with Section 230529 - Basic Mechanical Materials and Methods.

C. Provide enclosures, bumper protection or other accessories which may be required.

D. Install gas meter in accordance with local Utility Company's installation instructions, and comply with requirements of jurisdictional codes.

3.10 GAS PRESSURE REGULATOR

A. Install as indicated; comply with Utility requirements. Pipe atmospheric vent to outdoors (unless a vent-limited regulator is used), full size of outlet. Install gas shut-off valve upstream of each pressure regulating valve.

3.11 TESTS

A. General: Test fuel supply lines with air under pressure before being covered. Use a calibrated, certified static gauge graduated to one pound per square inch.

B. Testing shall be of the complete piping system, before covering, or of individually separable larger portions of the system. Only the last connection to the appliance may be tested under operating conditions. This connection will be tested with soap and brush under line pressures. This connection must remain exposed.

C. Test Procedures: Use either of the following methods at the Contractor's option:

1. 30 psig air pressure for a period of 24 hours with no drop in gauge pressure, indicating the line to be airtight.
2. 100 psig air pressure, with joints tested with standard soap and brush inspection and maintain for 3 hours without drop in pressure.

D. Retesting: Retest piping failing initial tests following correction of defective work. Requirements of initial tests shall apply.

E. Test Records: Record pressure and ambient temperature at start and end of test. Submit written results of test to the Architect/Engineer.

END OF SECTION 231123

SECTION 232113 - HVAC PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230548 - Mechanical Seismic Control
Section 230700 - Mechanical Insulation
Section 232123 - HVAC Pumps
Section 235200 - Boilers
Section 236400 - Refrigeration
Section 235700 - Heat Transfer
Section 233400 - Air Handling Fans
Section 237400 - Air Handling System on Roof
Section 233300 – Ductwork and Accessories
Section 230900 - Electronic Controls
Section 230593 - Testing, Adjusting and Balancing
Section 238146 – Heat Pumps

C. Work installed but furnished under other Sections:

1. Condenser water bypass valve.
2. Pot Feeders, Water Meters, Solenoid Water Valves with Strainers and Manifolds furnished under Section 232500 - HVAC Water Treatment.
3. Flexible pipe connectors - Section 230540.
4. Flow switches in the chilled and condenser water piping.
5. Two-way automatic control valves.
6. Three-way automatic control valves.
7. Cabinet heater aquastat.
8. Unit heater aquastat.
9. Temperature sensing wells.

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

1. Hot water heating piping system and specialties.
2. Condenser water piping system and specialties.
3. Solar piping system and specialties.
4. Relief Valves.
5. Diaphragm - Type Bladder Tanks.
6. Air Vents.

7. Air Separators.
8. Strainers
9. Pump Suction fittings.
10. Radiator Valves.
11. Valves in accordance with Section 230529.
12. Pipe hangers and supports, saddles and shield in accordance with Section 230529.
13. Expansion joints, anchors and guides.
14. Mechanical sound and vibration control in accordance with Section 230540.
15. Antifreeze glycol treatment and specialties.
16. Installation of automatic control valves.
17. Flow Measuring Stations.
18. Water Meters.
19. Tests.

1.3 QUALITY ASSURANCE

A. Welder Qualifications: Welding shall be performed by an NCPWB Certified Welder with current certificate in accordance with ANSI B31.9 for shop and project site welding of piping work.

1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with American Welding Society (AWS) National Certified Pipe Welding Bureau (NCPWB) and American National Standards Institute (ANSI) Code Numbers B31.2, B31.9 as applicable for welding requirements.
2. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.
3. ANSI/ASME - Boiler and Pressure Vessel Code.
4. ANSI/ASME B31.9 - Building Services Piping.
5. ANSI/AWS D1.1 - Structural Welding Code.
6. ANSI/ASME Sec. 9 - Welding and Brazing Qualifications.
7. ASTM B32 - Solder Metal.
8. ANSI/AWS A5.8 - Brazing Filler Metal.

1.5 SUBMITTALS

A. Submit Shop Drawings for the following items under provisions of The General Conditions of the Contract.

1. Water Storage Tanks.

B. Submit Product Data for the following items under provisions of The General Conditions of the Contract.

1. Diaphragm-Type Bladder Tanks.
2. Air Separators.
3. Strainers.
4. Flow Indicators, Flow Switches.

5. Flow Measuring Stations.
6. Flow Meters.
7. Balancing Valves.
8. Thermometers.
9. Pressure Gauges.
10. Expansion Joints and Guides.
11. Backflow Preventer.
12. Blowdown Separator.
13. Pressure Regulating Valves.
14. Water Meters.
15. Water Storage Tanks.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500.

1. Diaphragm-Type Bladder Tanks.
2. Air Separators.
3. Strainers.
4. Flow Indicators.
5. Flow Measuring Stations.
6. Flow Meters.
7. Balancing Valves.
8. Water Meters.
9. Expansion Joints and Guides.
10. Backflow Preventer.
11. Blowdown Separator.
12. Pressure Regulating Valves.

C. Test Reports: Submit certified test reports for the following showing compliance in accordance with the General Conditions of the Contract:

1. Piping pressure tests.
2. Piping systems cleaning and flushing per Section 232500.
3. Certificates: Before proceeding with the Work, submit to the Architect/Engineer/Construction Manager/General Contractor, two copies of Certification that the welding work will be done according to ANSI B31.1 by welders who have been tested and whose qualification test sheets are available, attesting to their ability to weld in accordance with Standard Procedure Specifications as established by the National Certified Pipe Welding Bureau.

1.6 PROJECT CONDITIONS

A. Contractor shall not fabricate or install any piping until he has assured himself that the piping can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

1.7 SEQUENCING/SCHEDULING

A. Coordinate any system shutdown with Campus Project Manager not less than 7 days prior to prooposed shutdown.

1.8 GLYCOL MAINTENANCE SERVICE

A. Provide the services of a fully qualified Field Superintendent and technical assistance for one year warranty period. Services and assistance shall include the following:

1. A training session for the Owner's operating personnel instructing them clearly and fully on the installation, maintenance and testing of the Glycol Systems.
2. A quarterly technical service visit to the jobsite to make glycol fluid concentration analysis on site with a refractive index measurement instrument. The Field Superintendent shall detail findings with the proper personnel in writing on proper practices and any corrective actions needed to protect the Glycol Systems with the proper concentrations of glycol and inhibitors.

3. Include in the analysis the amount of Inhibited Propylene Glycol to be added or diluted to obtain the correct concentration specified for each system containing glycol.

1.9 EXTRA STOCK

A. Glycol: Provide sufficient Inhibited Propylene Glycol to maintain specified concentrations in HVAC Piping Systems during one year warranty period.

PART 2 - PRODUCTS

2.1 HEATING WATER PIPING, HEAT PUMP CONDENSER WATER PIPING (16-200 PSIG)

A. Pipe:

2 Inch or smaller	ASTM A53, Schedule 80 black buttweld or continuous welded steel.
2 Inch or smaller	ASTM A53, Grade A, Schedule 80, black CWS, CWR, HWS, HWR screwed malleable iron fittings.
2-1/2 Inch or larger	ASTM A53, Grade A or B, Schedule 40 black seamless steel or continuous welded steel.

B. Fittings: 300 psi rated.

2 Inch or smaller	ASTM A197, A234, Class 250, Schedule 80 weld fittings.
2 Inch or smaller CWS, CWR, HWS, HWR	ASTM A234, Grade A, Schedule 80, black, malleable iron screwed.
2-1/2 Inch or larger	ASTM A234, Grade A, Schedule 40 weld fittings.

C. Unions:

2 Inch or smaller	Class 250, Schedule 80, black malleable iron screwed bronze to iron, ground joint.
2-1/2 Inch or larger	Use Schedule 40 flanges.

D. Gaskets:

All Sizes	Class 250,1/8 inch full faced metal spiral wound, 304 stainless steel and flexible graphite filled with entering ring and inner ring.

E. Bolting: ASTM A370, Grade B, regular square head machine bolts with heavy hex nuts.

F. Flanges:

All Sizes	ASTM A181, Grade 1, Class 250 slip-on or weld neck flat faced.

2.2 HEATING WATER, HEAT PUMP, CONDENSER WATER, SOLAR SYSTEM FLUID, PIPING (LESS THAN 90 PSIG)

A. Steel Pipe:

1. Pipe:

2 Inch & Smaller	ASTM A53, Grade A, Schedule 40 black buttweld or continuous welded steel.
2-1/2 Inch & Larger	ASTM A53, Grade B, Schedule 40 black buttweld or continuous welded steel.

2. Fittings:

2 Inch & Smaller	ASTM A197, Class 150 black malleable iron screwed.
2-1/2 Inch & Larger	ASTM A234, Steel butt weld, standard weight forged fittings.

3. Unions:

2 Inch & Smaller	Class 150 black malleable iron screwed bronze to iron, ground joint.
2-1/2 Inch & Larger	Use flanges or grooved couplings.

4. Gaskets:

All Sizes	Class 250 1/8 inch full faced metal spiral wound, 304 stainless steel and flexible graphite filled with entering ring and inner ring.

5. Bolting: ASTM A307, Grade B, regular square head machine bolts with heavy hex nuts.

6. Flanges:

All Sizes: ASTM A181, Grade 1, Class 150 slip-on or weld neck flat faced.

B. Copper Tubing:

1. Tube:

Up to 4" inclusive: ASTM B 88, Type L, hard drawn.

2. Fittings:

a. ANSI/ASME B16.23 cast brass and/or
b. ANSI/ASME B16.29 solder wrought copper
c. ProPress fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117.

3. Joints:

a. ASTM B32, solder, Grade 95 TA.
b. ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117 for ProPress Fitting connections.

2.3 CONDENSER WATER PIPING, BURIED

A. PVC Pipe: ASTM D1785, Schedule 40, and Schedule 80 for sizes 8 inch and larger, or ASTM D2241, SDR 21 or 26.

1. Fittings: ASTM D2466, or D2467, PVC.
2. Joints: ASTM D2855, solvent weld.

B. Cast Iron Pipe: ANSI/AWWA C151

1. Fittings: Ductile iron, standard thickness.
2. Joints: ANSI/AWWA C111, rubber gasket with 3/4 inch diameter rods.

2.4 SOLVENTS FOR PLASTIC PIPING

A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule 1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

2.5 CONDENSER WATER PIPING FOR GROOVED PIPE OPTION IN BUILDING

A. General: At Contractor's option, condenser water piping may be mechanical roll grooved pipe couplings, fittings and butterfly valves.

B. Acceptable Manufacturers: Victaulic, Anvil/Gruvlok, Grinnell.

C. Chilled water piping includes risers, mains, equipment connections, branches, supply and return lines under operating conditions not exceeding minus 30 degrees Fahrenheit to plus 230 degrees Fahrenheit.

1. Pipe: ASTM A53, 3/4 inch to 1-1/2 inch Type F; 2 inch to 20 inch Type E or S, Grade B Standard roll grooved to coupling manufacturer's specification, standard weight steel pipe.
2. Couplings: Line and fitting joints to be Victaulic "Style 75 or 77" with Grade "E" gaskets and nuts and bolts. Rated –30°F. to 230°F, or Central Sprink “Style 705 or 707" or Gruvlok 7001.
3. "Rigid" line fitting and valve joints to be Victaulic "Style S-07" Couplings with or Grade "E" gaskets and nuts and bolts or Gruvlok 7401.
4. Joints designated Outlet Couplings to be Victaulic "Style 72" with Grade "E" gaskets and nuts and bolts or Gruvlok 7042.
5. Joints designated Reducing Couplings to be Victaulic "Style 750" with Grade "E" gaskets and standard nuts and bolts or Gruvlok 7010.
6. Flanged components connections to be Victaulic "Style 741 Vic-Flanges" with Grade "E" gaskets or Gruvlok 7012.
7. Fittings: Fittings to be Victaulic or Gruvlok "Full Flow" malleable iron or ductile iron or segmentally welded fittings, with grooved or shouldered ends.
8. Valves: Butterfly valves 2" - 12" inch to be Victaulic S/300 or Gruvlok 7700 with 300 psi rating, latch-lock throttling handles, Grade "E" linings and standard trim. Sizes 14" - 24" to be Victaulic S/708 with 175 psi rating. Valves greater than or equal to 8” shall be supplied with gear operator.
9. All materials to be manufactured in the USA, and must be designed and intended for use on HVAC systems. No fire sprinkler parts are allowed.

2.6 STATIONARY PRESSURE GAUGES

A. Acceptable manufacturers: Trerice 600C Series, Weksler Regal Series, Weiss Instruments, Miljoco.

B. Schedule: All gauges will be liquid filled.

Plan Code	PG-1	PG-2
Type	4-1/2” Dial	4-1/2” Dial
Bourdon tube/socket	Phosphor bronze tube brass socket	Stainless steel tube 316 stainless steel socket
Accuracy	ANSI B40.1 Grade 1A 1% FS over middle half of range	ANSI B40.1 Grade 1A 1% F.S. over middle half of range
Case	Cast aluminum	Cast aluminum
Window	Clear glass	Clear glass
Snubber	Yes	Yes
Coil siphon	For steam service	For steam service
Gauge cock	Yes	Yes
Set hand	No	No
Silicone filled	No	No
Weatherproof	No	No

C. Range: Select gauges for the following standard ranges unless otherwise indicated on drawings, or as required for special systems:

1. Domestic Water 0 to +160 psi
2. Low Pressure Steam -30 in Hg to +60 psi
3. Pump Gauges -30 in Hg to +100 psi

2.7 STATIONARY THERMOMETERS

A. Acceptable manufacturers: Trerice Industrial Series, Ametek Industrial Series, Weiss Instruments, Miljoco, Weksler.

B. Schedule:

Plan Code:	T-1
Type	Adjustable angle
Case	9" cast aluminum
Window	Clear acrylic
Tube	Thermistor
Stem	Aluminum, insertable
Separable Socket	Brass

C. Range: Select thermometers, for the following standard ranges unless otherwise indicated on Drawings, or as required for special systems.

1. Condenser water 0 to 100 °F
2. Heating water 30 to 240 °F
3. Reclaim water 0 to 100 °F
4. Domestic cold water 0 to 100 °F
5. Domestic hot water 30 to 240 °F

2.8 TEMPERATURE AND PRESSURE TEST PLUGS (T&PTP)

A. Manufacturer: Trerice, Fairfax, Flow Design, Peterson Equipment (Pete's Plug), Sisco.

B. Plugs suitable for vacuum to 600 psig and temperatures of -20 deg.F to 300 deg.F with cap and extension for insulated pipe where required.

C. Provide one pressure gauge, gauge adapter, and two thermometers in shock-proof case.

D. Schedule:

PLAN CODE:	MAKE:	MODEL:	PRESSURE & TEMPERATURE TEST KIT
T&PTP	Trerice	D3741	Trerice D3750 (0-100 psig)

2.9 EXPANSION JOINTS, ANCHORS AND GUIDES

A. Approved Manufacturers: Barco, Flex-Hose, Metraflex, Hyspan.

B. Provide expansion joints where called for on drawings or otherwise necessary to prevent noise or damage.

C. Exposed Bellows Expansion Compensator: Stainless steel bellows with internal stainless steel liner, carbon steel ANSI flanges or Schedule 80 beveled weld ends as indicated in schedules. <Include tie rods with spacers to prevent over-elongation and over-compression of the unit>. Expansion compensator must be rated for operating temperatures up to 600°F and operating temperatures up to 150 psi.

D. Externally Pressurized Expansion Compensators: Stainless steel multi-ply bellows with internal guides, internal stainless steel liner, and a heavy wall outer housing designed for line pressure. Operating fluid pressure inside compensator is transferred to the outside of the bellows through a gap between internal guide flange and the outer housing. Entire assembly to be sealed to contain fluids and pressure, and shall include a drain port in the outer housing. Unit to be rated for operating pressure of 150 psi and operating temperature up to 700°F. Unit to be a packless design, maintenance free design. Guarantee a minimum of 10,000 full travel cycles without failure. Use Metraflex Metragator, Flex-Hose Flexpress, or equal from list of approved manufacturers.

E. Braided Pipe Seismic Connectors: Two or three equal lengths of annular corrugated flexible stainless steel hose with stainless steel overbraid and four stainless 90° elbows, resulting in a device that absorbs/compensates for pipe motion in all 6 degrees of freedom simultaneously. Device shall allow for ± 4” of pipe motion in any direction. Unit to be rated for operating pressures of 150 psi and operating temperatures of 600°F. Include support lugs on elbows and fitting on distant elbow for drain plug or air relief valve. Use Flex-Hose, Tri-Flex Loop or equal from list of approved manufacturers.

F. Pipe Guides: Provide pipe guides and anchors as shown on drawings or as recommended by expansion joint manufacturer. Pipe guides must allow axial movement of pipe while eliminating lateral pipe movement. Guides to be constructed of painted carbon steel, and consist of a two-piece split spider clamp that bolts around the pipe, and a two-piece bolted split housing with integral base that anchors the unit to the structure. Pipe anchors shall be made of carbon steel, are to be welded to the pipe they serve, and are to be painted to protect the anchor and welds from corrosion. Anchors to include an integral base that bolts to the structure.

2.10 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; 1/16 inch thick preformed neoprene bonded to asbestos.

C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; C-shape elastomer composition sealing gasket for operating temperature range from -30 degrees F to 230 degrees F; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

2.11 RELIEF VALVES

A. Acceptable Manufacturers: Kunkle, Watts, McDonnell and Miller, Lonegren, Conbraco, Spirax Sarco.

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

C. Size as required for maximum operating pressure and heat transfer capacity of the equipment. Provide relief valve in each system to protect piping, tanks, and equipment.

2.12 PUMP SUCTION FITTINGS

A. Acceptable Manufacturers: Bell and Gossett, Armstrong, Paco, Allis Chalmers, Weinman, Peerless, Aurora, Amtrol, Wheatley, Taco, Victaulic, Gruvlok, Patterson, Gustin Bacon.

B. Pump suction fitting inlet size shall match line size and outlet size and shall match specified pump provided by Contractor.

C. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, or grooved fittings for grooved pipe, rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

D. Maximum allowable pressure drop across pump suction fitting at system design flow is 1 psi. Provide reducer as necessary to connect pump suction to pump inlet.

E. Accessories: Adjustable foot supports, blowdown tapping in bottom, gauge tapping in side.

2.13 FLOW INDICATORS

A. Acceptable Manufacturers: McDonnell and Miller, Mueller.

B. Brass construction, threaded for insertion into piping system, packless, with paddle with removable segments, vapor proof electrical compartment with switches.

2.14 AIR ELIMINATORS (HEATING WATER SYSTEMS)

A. Air Eliminators: Steel, max. working pressure 150 psi, ASME stamped, max. working temp. 270°F, turbulence suppressive design, integral air chamber with automatic vent valve, skimming valve, blowdown connection. Acceptable manufacturers: Spirotherm - Spirovent Senior, Wessels.

2.15 STRAINERS

A. Acceptable Manufacturers: Armstrong, Boylston, AW Cash, ITT, Hoffman, Keckley, Mueller, Trane, Metraflex, Victaulic, Gustin-Bacon, Conbraco, Spirax Sarco, Gruvlok, IFC.

B. Size 2 inch and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch: Flanged or grooved iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. Size 5 inch and Larger: Flanged or grooved iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.16 DIAPHRAGM-TYPE BLADDER TANKS

A. Acceptable Manufacturers: Bell and Gossett, Amtrol, Woods, Taco, Wheatley, Armstrong, Flexcon, Wessels, Patterson.

B. Provide tanks of size and capacity shown on Drawings.

C. Construction: Welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM bladder sealed into tank, and steel legs or saddles.

D. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to required psig.

2.17 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/4 inch copper tubing to a floor drain or sink with petcock at working level, ground.

B. Balanced Pressure Thermostatic Air Vents for Steam Systems: Self-adjusting balanced pressure thermostatic type with stainless steel bellows. Stainless steel head and seat, cast iron body. All internals must be accessible for maintenance.

2.18 RADIATOR VALVES

A. Acceptable Manufacturers: Dunham-Bush, ITT, Hoffman, Illinois, Trane, Danfoss, Weksler, Runtal.

B. Angle or straight pattern, rising stem, inside screw globe valve for 125 psig working pressure, with bronze body and integral union for screwed connections, renewable composition disc, plastic wheel handle for shut-off service, and lockshield key cap and set screw memory bonnet for balancing service.

2.19 INHIBITED PROPYLENE GLYCOL (Antifreeze Heat Transfer Fluid)

A. Product: The Dow Chemical Company - Dowfrost Heat Transfer Fluid, Huntsman, JeffCool P150.

B. Description: An inhibited propylene glycol that is clear and odorless.

C. Provide: In specified concentrations in HVAC Water Piping Systems listed in Part 3 of this Section 232113.

2.20 FLOW MEASURING SYSTEM

A. Acceptable Manufacturer: Griswold Corporation, Febco, Bell & Gossett, Armstrong, Gerand, Spirax Sarco.

B. Provide automatic pressure compensating flow control valves. The F.C.V. and housing shall be in a factory-assembled unit consisting of a flow controller with bronze union fittings with EPR "0" -ring seals, pressure and/or temperature plugs and ball valve. Flow control valves shall have the flow rates and pressure differential as indicated and strictly conform without exception to the following:

1. The control mechanism of the F.C.V. shall be a coiled/helical spring 17-7 PH. Wave springs are not acceptable. The cartridge for the coiled/helical spring shall be stainless steel. Plated materials are not acceptable. Cartridge must be removable in one piece.
2. Flow control valves must be available in four pressure differential operating ranges:

   1 to 14 PSI Drop
   2 to 32 PSI Drop
   3 to 57 PSI Drop
   4 to 128 PSI Drop

3. They shall be factory calibrated and automatically limit the rate of flow to the design flow rate indicated on the Drawings within + or - 5 percent accuracy over an operating pressure differential of at least 14 times the minimum required for control.
4. F.C.V. with an operating pressure differential of one range from 3 to 40 PSI Drop are not acceptable.
5. F.C.V. manufacturer shall warranty to the owner the F.C.V. for a period of two years from date of purchase.
6. All flow control valves shall have two union fittings to provide easy access and removal of the flow control from either the supply or return pipeline.
7. Each automatic flow control valve shall be furnished with a valve kit consisting of 1/4 inch by 2 inch minimum size nipples, quick-disconnect valves (to be located outside of insulation), and fittings suitable for use with the measuring instruments specified.
8. Provide a metal identification tag, with wire, for each flow control valve. The tag to be marked with zone identification, valve model number and rated flow in GPM.
9. All automatic flow controls shall be factory marked to show the direction of flow.
10. A flow pressure and temperature measuring kit shall be furnished to the owner upon completion of the job.
11. The pressure/temperature kit shall be portable and consist of pressure gauges, thermometer, connections and a carrying case.
12. Correct flow shall be verified by establishing that the operating pressure differential across the valve tappings is within the operating range indicated on the submittal data sheet for that model number.
13. Temperature measurement is to be determined by insertion of a thermometer into the fluid media via the temperature plug.

2.21 FLOW MEASURING STATIONS (VENTURI)

A. Furnish and install for each heating water, chilled water, and condenser water system where shown on drawings, complete Barco Venturi Flow Measuring System as manufactured by Hyspan Barco, Flow Design, Febco, Bell & Gossett, Preso, Armstrong, Gerand.

B. Each primary flow element shall be a Venturi selected from manufacturer's engineering data to permit prescribed flow at a minimum of head loss. The beta ratio shall be selected to allow for a differential pressure compatible with the meter as specified herein and insure a properly calibrated system accuracy within 1% throughout the entire range. Each Venturi shall be furnished with 2 built-in sensing taps, nipples, shut-off valves, and quick connect couplings. Venturis shall be complete with identification tag on chain, giving pipe size, Venturi series, station identification and meter reading at specified flow rate. Furnish flow vs. differential pressure curves and installation instructions.

C. Venturi stations shall be one-piece bronze threaded 1/2" through 3". Sizes 2-1/2" through 3" shall consist of one-piece cadmium plated cast steel Venturi with weld neck or flanged ends.

D. Venturi sizes and beta ratios shall be selected so that design flow rates shall read between 20% and 80% of the full scale range on a linear meter with permanent pressure loss of not more than 25% of indicated flow rate differential pressure.

E. Provide with portable indicating meter with 6” round dial, 270 degrees indication. It shall be the dual rupture-proof liquid filled bellows type with integral temperature compensation. The meter shall have over-range protection in either direction equal to the working pressure equivalent of the instrument housing (250 psig at 250 deg.F). The accuracy of the meter shall be no less than 0.5% full scale. The meters case shall be waterproof coated with appropriate paint. It shall have external zero and range adjusting screws and life-long lubrication. Scale shall be calibrated uniformly either in differential pressure; percent of flow; or directly in gpm.

1. Portable Master Meters shall be mounted in a durable metal reinforced plastic carrying case with the following accessories:

   a. Two 10” lengths of connecting hose, each with color coded quick connect couplings compatible with the Venturi couplings.
   b. Two brass blow-down valves with Buna-N seals.
   c. Blow-down hoses.
   d. Instruction book with flow vs. differential curves.

2.22 BALANCING VALVES (TERMINAL EQUIPMENT)

A. Acceptable Manufacturer: Bell & Gossett, Gerand, Armstrong, Taco, Amtrol, Tour & Andersson, Flow Design, Gruvlok, Danfoss.

B. Furnish and install calibrated balancing valves with screwed, sweated, or flanged connections suitable for 125 psig. Maximum working temperature shall be 250°F. Valves shall be equipped with brass readout valves fitted with an integral EPT insert and check valves designed to minimize system fluid loss during the balancing and monitoring process. Each balancing valve shall have a calibrated nameplate to assure specific valve settings, be constructed with internal seals to prevent leakage and be supplied with preformed Polyurethane insulation suitable for use on heating and cooling system.

C. Provide a metal identification tag, with wire, for each flow control valve. The tag to be marked with zone identification, valve model number, and rated flow in GPM.

D. Correct flow shall be verified by establishing that the operating pressure differential across the valve tappings is within the operating range indicated on the submittal data sheet for that model number.

2.23 DIAPHRAGM –TYPE EXPANSION TANKS

A. Acceptable Manufacturers: Bell and Gossett, Amtrol, Wessels, Woods, Taco, Wheatley, Armstrong, Flexcon.

B. Provide tanks of size and capacity shown on Drawings.

C. Construction: Welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPFDM diaphragm sealed into tank, and steel legs or saddles.

D. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

2.24 INHIBITED PROPYLENE GLYCOL (Antifreeze Heat Transfer Fluid)

A. Product: The Dow Company – Dowfrost Heat Transfer Fluid; Huntsman, JeffCool P150.

B. Description: An inhibited propylene glycol.

C. Provide: In specified concentrations in HVAC Water Piping Systems listed in Part 3 of this Section 232113.

PART 3 - EXECUTION

3.1 PIPE WORKMANSHIP

A. Piping shown on the drawings shall be installed complete, and shall be of the size shown on the drawings. When a size is not indicated, the sub-contractor shall request the pipe size from the Architect/Engineer thru the General Contractor. All piping shall be installed parallel or perpendicular to the building construction. All piping shall be installed so as to allow for expansion. Install saddles and shields per Section 230529.

B. Relief Valve: Install a 1” safety relief valve, set at a pressure no more than 5 psig less than the relief valve on boiler or chiller evaporator barrel, to protect against damage by expanding liquid or other source of overpressure during test or normal operation. Discharge of this system relief valve shall be piped to the glycol fill tank for recovery of glycol should relief valve be discharged.

3.2 PIPE SLOPE

A. Slope all domestic water, heating water and condenser water piping at 1”/40’ toward drains.

3.3 PIPING JOINTS

A. All pipe shall be reamed to full pipe diameter before joining. Screwed joints shall be made with standard pipe thread, and an approved compound applied to the male thread only. Welded joints shall be made in accord with the procedure outlined in National Certified Pipe Welding Bureau, or by other reputable testing laboratory or agency. Subcontractor shall use only "Threadolet" or "Weldolet" fittings for intersection welding of branches to mains. Valves and specialties shall have screwed or flanged joints. No bushings allowed.

B. All pipe shall be reamed to full pipe diameter before joining. ProPress fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect™) feature design (leakage path). In ProPress ½" to 4" dimensions the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

C. Pull tee (T-drill) fittings are forbidden.

3.4 SYSTEM PRESSURE SETTINGS

A. Hot Water Heating System: Set pressure reducing fill valve or glycol fill system to maintain 10 psig at highest point in system. Pre-charge bladder-type expansion tank to 2 psig less than "fill" pressure prior to connection to the system.

B. Slope all domestic water, heating water, and condenser water piping at 1"/40' toward drains.

3.5 RELIEF VALVES

A. Provide a pressure relief valve in each closed loop system set at 1.2 times the maximum operating pressure.

3.6 EXPANSION JOINTS, ANCHORS AND GUIDES

A. Pipe anchors shall be installed as shown and at the closest feasible point to all changes in pipe direction and elevation and at main branch take-offs, except at expansion loops. All piping shall be supported, anchored, braced and guided to control expansion-contraction and pipe movement due to pressure or shock, and to result in quiet operation.

3.7 BALL JOINTS

A. Install ball joints and anchoring for piping where it crosses expansion joints of building.

3.8 AUTOMATIC CONTROL VALVES

A. Install automatic control valves as required and specified in Section 230900 - Electronic Controls.

3.9 AIR VENTS

A. At all changes in elevation downward in direction of flow, and where shown, provide a manual air vent as follows: install a full size air chamber and pipe down with 1/4 inch copper tubing to a petcock. If the vent is above a ceiling, install the petcock just above the ceiling. Provide air vent fittings (manual) on hydronic coils.

3.10 PIPING CONNECTORS

A. Install flexible pipe connectors at equipment coils and pumps and elsewhere as required to accommodate thermal expansion, misalignment and vibration in accordance with Section 230540 - Mechanical Sound and Vibration Control.

3.11 AIR SEPARATOR

A. Contractor shall remove and clean strainer after 24 hours operation and after 30 days.

3.12 FLOW SWITCHES

A. Contractor shall furnish and install flow switches for mounting in chilled water and condenser water piping of each chiller machine.

3.13 THERMOMETERS AND PRESSURE GAUGES FOR BOILER, HEAT EXCHANGER INSTALLATION

A. Contractor shall furnish and install a set of four adjustable, indicating type, self-powered digital thermometers of the separable socket adjustable type in glass faced metal cases. They shall be placed in the piping adjacent to the machine in the following locations or heat exchanger as indicated in the details:

1. Condenser water line entering heat exchanger.
2. Condenser water line leaving heat exchanger.
3. Heating water line entering boiler.
4. Domestic water line entering heat exchanger.
5. Heating water line leaving boiler.
6. Domestic water line leaving heat exchanger.
7. Where indicated on plans, details and schematics.

B. Thermometer bulb shall project sufficiently into pipe (at least 1/3 of nominal pipe diameter) to accurately measure water temperature. Cases shall clear insulation.

C. Contractor shall provide and install gauge valves and gauges so that water pressure difference across these vessels is indicated.

D. Mount thermometers and gauges in a readily accessible location and easily read in a standing position from the equipment room floor.

E. Provide a shut-off valve on the branch line to each pressure gauge located in the system.

3.14 BACKFLOW PREVENTER

A. Provide on cold water make-up line to heating water and chilled water piping systems. Locate on high pressure side of reducing valve on system water make-up line.

3.15 TESTS

A. General: Provide test pump, gauges, meters, other instruments, materials, and labor, in connection with tests.

B. Relief Valve: Install a 1” safety relief valve, set at a pressure no more than 5 psig less than the relief valve on boiler or chiller evaporator barrel, to protect against damage by expanding liquid or other source of overpressure during test or normal operation. Discharge of this system relief valve shall be piped to the glycol fill tank for recovery of glycol should relief valve be discharged.

C. Pressure Tests: Before testing piping systems, remove or otherwise protect from damage, control devices, air vents and other parts which are not designed to stand pressure used in testing piping.

D. Hydrostatic Pressure: Test hydronically, piping for all services (except pneumatic system compressed air) to 125 psi or 1.5 times the maximum working pressure, whichever is greater, for at least six consecutive hours, during which time pressure shall remain constant without pumping. Subject welded joints to the hammer test, and copper joints to soap suds while under hydrostatic pressure.

3.16 CLEANING OF PIPING SYSTEMS

A. Provide for the cleaning of the HVAC Water Piping Systems after hydrostatic tests have been completed and prior to the operating tests in accordance with Section 232500 - HVAC Water Treatment.

B. Pipe in parallel with the water system to be monitored in accordance with piping diagram and instructions provided by Section 232500 Contractor.

3.17 ANTIFREEZE GLYCOL TREATMENT

A. After each system has been cleaned and flushed as described in "CLEANING OF PIPING SYSTEMS", it shall be filled with a solution of water and the following percentage by volume of inhibited propylene glycol:

Solar Water System	40%

B. Provide inhibited propylene glycol of type and formula specified for use in above described systems. Do not use any of the following:

1. Ethylene glycol
2. Standard automotive anti-freeze
3. Any solution with oil-base additives

3.18 HVAC WATER TREATMENT

A. Provide valved tees and piping and 3/4 inch threadolets for water treatment apparatus in accordance with Section 232500 HVAC Water Treatment Contractor instructions.

3.19 P&T PLUGS

A. Provide P&T Plugs at all hot water and heat pump water coils, water side of heat exchangers and heat transfer devices.

END OF SECTION 232113

SECTION 232123 - HVAC PUMPS

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1 General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230548 – Mechanical Seismic Control
Section 230593 - Testing, Adjusting and Balancing
Section 230700 - Mechanical Insulation
Section 230900 - Electronic Controls
Section 232113 - HVAC Piping and Specialties
Section 233400 - Air Handling Fans
Section 235200 - Boilers
Section 235700 - Heat Transfer
Section 236400 - Refrigeration
Section 237400 - Air Handling System on Roof

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to, providing the following:

1. Heating water and heat pump system pumps.
2. Condenser water system pumps.
3. Mechanical sound and vibration control in accordance with Section 230540.

1.3 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.

1.4 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data including materials of construction, actual impeller size, pump speed, motor size, motor efficiency, motor amps, mounting requirements, weights, dimensioned drawings, and performance curves at scheduled flow conditions and 120% of scheduled head, for the following items in accordance with the General Conditions of the Contract:

1. Heating water system pumps.
2. Heat pump water system pumps.
3. Condenser water system pumps.

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500.

1. All pumps.

PART 2 - PRODUCTS

2.1 IN-LINE TYPE WATER PUMPS

A. Approved Manufacturers: Bell & Gossett, Armstrong, Taco, Paco.

B. Selection Criteria: Pumps shall be selected to satisfy the specified flow/head conditions shown on pump schedule while in the mid-range of the selected pump performance curve. Pump shall be capable of delivering the scheduled flow with 120% of the scheduled head with only a change of impeller size.

C. Motor to be non-overloading throughout the range of the pump curve and in accordance with "Motors" in Section 230529. Provide variable frequency drives where indicated, in accordance with Section 230810.

D. The impeller shall be of the enclosed type, dynamically balanced and keyed to the shaft and secured with a suitable locknut.

E. Pump seal shall be standard single mechanical seal with carbon seal ring and ceramic seat.

F. A replaceable shaft sleeve shall be furnished to cover the wetted area of the shaft under the seal or packing.

G. The bearing frame assembly of the pump shall be fitted with regreaseable ball bearings equivalent to electric motor bearing standards for quiet operation.

H. The pump and motor shall be mounted on a common baseplate of heavy structural steel design with securely welded cross members and open grouting area. A flexible EPDM coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor, and it shall be equipped with a suitable coupling guard as required.

I. The pump shall be factory tested, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. A set of installation instructions shall be included with the pump at the time.

J. Manufacturers: Bell and Gossett, Armstrong, Taco, Paco, Allis Chalmers, Weinman, Peerless, Aurora, Grundfos, Patterson.

2.2 IN-LINE TYPE WATER PUMPS

A. Approved Manufacturers: Bell & Gossett, Armstrong, Taco, Paco, Grundfos, Patterson.

B. Selection Criteria Variable Speed Pump: Pumps shall be selected with the largest impeller available in the scheduled casing size. Submit pump selection indicating pump speed required to deliver scheduled flow and head.

C. Selection Criteria Constant Speed Pump: Pumps shall be selected to satisfy the specified flow/head conditions shown on pump schedule while in the mid-range of the selected pump performance curve. Pump shall be capable of delivering the scheduled flow with 120% of the scheduled head with only a change of impeller size.

D. Type - Pumps shall be selected for quiet operation. Pump curve shall be submitted for review, capacities and model number as shown on Drawings.

E. Motor to be squirrel cage induction type, with ODP enclosure and in accordance with "Motors" in Section 230529.

F. Pump Shaft - Shall be alloy steel, and shall have bronze sleeve-type bearings. Pump seal shall be of the mechanical type.

G. Motor: Shall be quiet operating type, 1750 RPM in accordance with "Motors" in Section 230529.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide installation in accordance with Section 230540 - Mechanical Sound and Vibration Control.

B. Lubricate the pumps in accordance with manufacturer's instructions after completion of the system and before start-up.

3.2 BASE MOUNTED CIRCULATING PUMPS

A. Valves and fittings in piping to pumps to be full line size with reductions made directly to pump suction (eccentric reducer) and discharge (concentric increaser).

B. Pumps and motors to be leveled and aligned on bases and foundation pads in strict accordance with the manufacturer's instructions and within their recommended tolerances using an indicating micrometer. This is to be done before any piping or electrical connections are made. After connections have been made and just prior to placing each pump in operation, recheck levels and alignments. Make adjustments to assure that the thrust is balanced, that shaft rotates freely when turned by hand, and that pump is quiet in operation. When adjustments are completed, tightly bolt and grout motor and pump.

3.3 HORIZONTAL SPLIT CASE CIRCULATING PUMPS

A. Valves and fittings in piping to pumps to be full line size with reductions made directly to pump suction (eccentric reducer) and discharge (concentric increaser), or reducing elbows.

B. Level and align pumps and motors on bases and foundation pads in strict accordance with the manufacturer's instructions and within their recommended tolerances using an indication micrometer. This is to be done by the pump supplier before any piping or electrical connections are made. After connections have been made and just prior to placing each pump in operation, recheck levels and alignments. Make adjustments to assure that the thrust is balanced, that shaft rotates freely when turned by hand, and that pump is quiet in operation. When adjustments are completed, tightly bolt and grout motor and pump.

3.4 IN-LINE TYPE WATER PUMPS

A. Each pump shall be installed with piping or pump shaft dead level as shown on drawings, and shall not touch nor rest on any part of building structure. Pumps over 3 HP shall be mounted against wall and within 4 feet above finished floor for ease of servicing.

B. Electrical connection to each pump shall be made through the use of flexible conduit (Greenfield) at least 18" long.

C. Each pump shall be so installed that pump can be completely removed without dismantling or removal of any piping or valves. No additional motor support will be allowed.

D. Motor and coupling shall be checked and properly aligned in strict accord with manufacturer's instructions. Motor/pump shaft shall be vertical or horizontal as required by manufacturer.

E. Adjacent piping shall be carefully fitted and erected so that pump can be installed or removed from pipe line without forcing or springing.

F. After system has been completed and pump started, each pump and system shall be checked for vibration and excessive noise, and any such noise or vibration shall be immediately corrected.

G. Change the cartridge filter on the flush line to the seals after the system has been flushed, and immediately prior to substantial completion.

3.5 SPLIT CASE CIRCULATING PUMPS

A. Valves and fittings in piping to pumps to be full line size with reductions made directly to pump suction (eccentric reducer) and discharge concentric increaser, or reducing elbows.

B. Level and align pumps and motors on bases and foundation pads in strict accordance with the manufacturer’s instructions and within their recommended tolerances using an indication micrometer. This is to be done by the pump supplier before any piping or electrical connections are made. After connections have been made and just prior to placing each pump in operation, recheck levels and alignments. Make adjustments to assure that the thrust is balanced, that shaft rotates freely when turned by hand, and that

pump is quiet in operation. When adjustments are completed, tightly bolt and grout motor and pump.

END OF SECTION 232123

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Pre-Startup cleaning of HVAC Piping Systems.

B. Pre-Startup cleaning of Boilers and Condensate Piping Systems.

C. Chemical Feeders.

D. Treatment for Closed Systems:

1. Heating Water
2. Solar System Fluid

E. Treatment for Open Systems:

1. Cooling Towers

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish only the following items to Section 232113 - HVAC Piping Contractor for installation:

Manifolds
Solenoid Water Valves with Strainers
Pot Feeders
Complete instruction for corrosion coupon rack
Motorized Ball Valves for solids separator blowdown/bleed

1.3 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

D. Section 221411 - Disinfecting Water Supply System.

E. Section 232113 - HVAC Piping and Specialties.

1.4 QUALITY ASSURANCE

A. The Water Treatment, Chemical and Service Company shall be a recognized specialist, active in the field of industrial water treatment for at least ten years, whose major business is in the field of water treatment, and shall have regional water analysis laboratories, development facilities and service department, plus full-time service personnel within the locale of the job site.

B. All products shall be provided by a single Contractor to ensure there being a single source of responsibility.

C. While it is recognized that there are, for most items, several equal brands and manufacturers, the bidders will for the purpose of this bid, offer only specified equipment and chemicals.

D. Acceptable Water Treatment, Chemical and Service Suppliers meeting the above requirements for this project are as follows:

2. West, Inc.

E. Campus treatment is currently West, Inc. Water treatment company providing service for this project will use compatible treatment service and follow West, Inc. standards and recommendations.

F. Firms not listed above must submit a list of satisfied customer service references and evidence of qualifications and experience for acceptance to execute the work on this project under provisions of the General Conditions of the Contract.

1.5 SUBMITTALS

A. Technical Data: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Water Treatment Materials and Equipment.
2. Control Diagrams.
3. Chemicals and quantity provided.

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data Paragraph in Section 230500.

1. All Water Treatment Equipment and Procedures.
2. Water Treatment Program Control Chart.

1.6 MAINTENANCE SERVICE

A. Provide the services of a fully qualified Field Engineer and laboratory and technical assistance from a fully qualified laboratory staff for one year warranty period. Services and assistance shall include the following:

1. A two hour training course for the Owner's operating personnel instructing them clearly and fully on the installation, care, maintenance, testing, and operation of

the water treatment systems. The training course shall be arranged by the Division 23 Contractor at the startup of the system.

2. A monthly technical service visit to the jobsite of the installation to perform field inspections and to make water analysis on site, both of such complexity as to evaluate the water systems operations. The Field Engineer shall detail findings with the proper personnel in writing on proper practices, chemical treating requirements, and any corrective actions needed to protect the water systems from scale, corrosion, and fouling. Two copies of the written field service report shall be forwarded to the Owner, Division 23 Contractor and the Engineer after each visit.
3. Be on call at no additional cost increase to the Contract Sum to make on-site inspections of equipment during scheduled or emergency outages in order to properly evaluate the success of the water treatment program, and to make recommendations in writing based upon these inspections.

1.7 EXTRA STOCK

A. Provide sufficient chemicals for treatment and testing during one year warranty period. If any system loses the chemicals due to pipe leaks or any other system malfunction, the Division 230000 Contractor shall replace the chemicals at no expense to the Owner. Chemicals shall not be harmful to the system in which they are used, and shall comply with Jurisdictional Codes governing the use and discharge of chemical formulations.

PART 2 - PRODUCTS

2.1 PRE-STARTUP CLEANER

A. Provide a pre-startup liquid alkaline dispersant cleaner for the flushing and cleaning of all HVAC water and Glycol and Solar Fluid systems to remove oil and foreign matter from the piping and equipment prior to the final filling of the systems. This chemical shall not be injurious to persons, piping, pipe joint compounds, packings, coils, valves, pumps, and their mechanical seals, tubes or other parts of the system. Cleaner to be left in system for 8 hours before flushing.

B. Provide a pre-startup liquid alkaline dispersant cleaner for the flushing and cleaning of the steam boilers and related equipment to remove oil and foreign matter from the equipment prior to startup.

C. Furnish complete instructions dictating the quantities of the cleaner to use, methods, and duration of the operation.

2.2 CHEMICAL FEED EQUIPMENT FOR CLOSED SYSTEMS

A. Provide pot feeders for the following closed systems:

1. Heating Water
2. Solar System Fluid

B. Feeder shall be bypass Pot Feeder of sufficient capacity with 3/4" brass drain valve. All feeders shall be able to withstand a maximum working pressure of 175 psi.

2.3 CLOSED SYSTEM WATER TREATMENT CHEMICALS

A. Provide liquid borate nitrite corrosion inhibitor plus an azole inhibitor treatment for the prevention of corrosion in closed systems at 700 PPM total nitrite level.

B. Note that some systems contain glycol provided under HVAC Piping Section 232113.

2.4 WATER TREATMENT CONTROL SYSTEM FOR COOLING TOWERS UNDER 100 TONS

A. Acceptable Manufacturers:

Water Treatment Control System: Lakewood Instruments, LMI.
Chemical Feed Pump: LMI, Prominent, Precision.

B. Provide an automatic condenser water control system which shall be completely automated for inhibitor feed, blowdown and biocide feeds. Inhibitor application and blowdown shall be conductivity activated, and directly responsive to variables in concentrations of the recirculating water. Biocides shall be automatically fed on an alternating basis with the blowdown locked out to insure proper biocide retention time in the recirculating water.

C. Control system shall incorporate the latest advantages of solid state technology including integrated circuits and digital LED displays. All control circuits shall be in a single NEMA-12 steel enclosure. Door shall be gasketed and lockable. The digital control system shall have the following features and capabilities:

1. TDS - The dissolved solids control portion of the system is based on conductivity and shall have the following features and accessories:

   a. LED digital readout display (micromho/cm).
   b. Temperature Compensated Sensor Probe adaptable to sample stream manifold.
   c. High, Low, Normal conductance indicator lights (LED).
   d. High or Low conductance alarm light (flash or steady switch), trip points field adjustable. Flash or Steady Switch shall have a Silence position.
   e. Illuminated Legend: "Alarm", whenever alarm condition exists. Cannot be disabled.
   f. HOA switch for solenoid bleed valve.
   g. Illuminated Legend: "Bleed", when valve is operated.
   h. Adjustable hysteresis or dead-band (internal).

2. Inhibitor Treatment - The inhibitor feed control portion of the system shall be based on blowdown and shall have the following features and accessories:

   a. Test Switch.
   b. HOA switch for chemical pump.
   c. Illuminated Legend: "Feed", when pump is activated.
   d. Solid State Lock-out Timer (adjustable 1/4 to 3 hours) and indicator light. Lock-out timer shall deactivate the pump and activate the alarm circuits described in TDS control section.

3. Biocide Programmer - The biocide programmer portion of the system shall have the following features:

   a. 24 Hour Timer with 14-Day Skip feature to permit the activation any hour of the day.
   b. Precision Solid State bleed lock-out timer (0-9 hrs.) and (0-2 1/4 hrs.) biocide pump timer, clock controlled.
   c. Solid State alternator to enable the use of two different formulations.
   d. Digital Display of the time of day (24 hours).
   e. LED display of day of week - 14 days.
   f. Fast and slow clock set controls (internal).
   g. Battery back-up on timekeeping, so clock is not disturbed by power outages. Quartz timekeeping accuracy.
   h. HOA switch for Biocide pump.

D. Provide two chemical feed pumps of suitable materials of construction that shall have adequate capacity to handle chemical inhibitors of variable pH. Pump shall be positive displacement, diaphragm type, with adjustable volume from 0-100% of capacity while in operation. Pump shall have a discharge relief valve for ease of priming. Maximum capacity shall be 24 gallons per day against 100 PSI to feed the chemical inhibitor directly from the shipping drum. Pump shall be 115/1/60 volts.

E. Provide a motorized ball valve for mounting on solids separator of sufficient size for adequate blowdown.

F. System shall include 3/4" PVC Flow Switch adaptable to sample stream piping manifold.

G. System shall include 3/4" PVC sample stream piping manifold system with three chemical injection tees, check valve, sample cock, shut-off valves, flow switch and probe fitting.

H. Provide spill containment basin under chemical treatment stand. Size basin to include pumps, chemical drums, and mounting stand. Construct basin of polyethylene, polypropylene, FRP, concrete, or other approved material. Secure basin and stand as required by Section 230548 – Mechanical Seismic Control.

2.5 OPEN SYSTEM WATER TREATMENT CHEMICALS

A. Provide an organic phosphonate based scale inhibitor containing molybdate and zinc based corrosion inhibitors and sludge dispersants. The treatment shall be in liquid form and be suitable for feeding into the system directly from the shipping container. This chemical treatment must <u>not</u> contain chromate or phosphate.

B. Provide algaecides of two different types of formulations to be used on an alternating basis and to be effective against all normally encountered algae and slime growths. Algaecides must be isolthizolone or gluteraldehyde.

C. Chemicals used in direct evaporative cooling media sumps shall be approved for use in the supply air stream by OSHA and EPA.

2.6 COOLING TOWERS WATER TREATMENT (IN ADDITION TO ABOVE WATER TREATMENT)

A. Manufacturer: Clearwater Dolphin or equivalent.

B. Furnish and install a pulsed power water treatment system, including line sized power chamber and control panel.

C. System Flow: See Drawings.

D. Continued maintenance to be provided by this manufacturer and contractor to include 1 year of bi-monthly monitoring of all equipment operation and water quality to ensure proper operation. Owner training during this time includes coordinating appointments and meetings on site to review monitoring results and make any adjustments required to systems.

2.7 WATER TREATMENT CONTROL TESTING EQUIPMENT

A. Provide testing chemicals to properly analyze the condenser water for organic phosphonate and closed system water for nitrite. Furnish the necessary test kits for these tests.

B. Provide a Myron L "DS" meter, single range, 0-5000 MICROMHOS/CM auto-temp compensation 50-160 deg.F, 9-volt transistor batteries, and built in cell cup.

C. Furnish a supply of log sheets on which to record the test results and bound copy of full test instructions.

D. Provide test kit for measuring the concentration of propylene glycol solutions, test instrument shall be of refractive index type with two-point calibration.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate where installation of equipment in piping systems is required with the Section 232113 - HVAC Piping Contractor and Electrical requirements per Section 230529 - Basic Mechanical Materials and Methods and provide installation instructions to those firms providing installation.

3.2 CLEANING OF PIPING SYSTEMS

A. Thoroughly clean the HVAC water and Glycol and Solar Fluid piping systems after hydrostatic tests have been completed and prior to the operating tests with liquid alkaline dispersant cleaner per instructions specified in Part 2 dictating the quantities of the cleaner to use, methods, and duration of the operation. Systems shall then be drained and thoroughly flushed out with fresh water.

B. Contractor shall notify Architect/Engineer prior to cleaning operation, and shall verify in writing to the Architect/Engineer after the system has been cleaned.

C. Failure of any part of the system due to improper cleaning or inadequate chemical feed shall be the responsibility of the Division 23 Contractor.

D. Division 232113 Contractor is to provide bypasses and isolation valves as required to allow circulation of cleaning solution in new piping system without allowing system cleaning solution to circulate through existing piping system. Coordinate proper bypass and isolation valve locations with Division 232113 Contractor to ensure proper cleaning of entire new HVAC piping systems.

3.3 COOLING TOWER WATER TREATMENT (ELECTRONIC)

A. Continued maintenance to be provided by this manufacturer and contractor to include 1 year of bi-monthly monitoring of all equipment operation and water quality to ensure proper operation. Owner training during this time includes coordinating appointments and meetings on site to review monitoring results and make any adjustments required to systems.

SYSTEM START-UP

A. The Water Treatment Supplier shall put the treatment equipment into operation, and make adjustments necessary for proper operation.

B. The Water Treatment Supplier shall provide a written report to the Division 23 Contractor indicating that the start-up has been completed and that all equipment is operating properly.

3.4 OPERATOR TRAINING AND SERVICE

A. The Water Treatment Supplier shall instruct the Owner's operating personnel so as to familiarize them with all treatment equipment and procedures per Maintenance Service specified in Part 1 of this Section. Minimum of 2 hours/system type.

B. The Water Treatment Supplier shall obtain a signed receipt from the Owner's operating personnel to confirm that adequate training has been received to operate the systems properly.

END OF SECTION 232500

SECTION 233300 - DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Low pressure ductwork.

B. Manufactured duct joints.

C. Casings.

D. Fibrous glass ductwork.

E. Kitchen hood exhaust ductwork.

F. Damper operator hardware.

G. Volume control dampers.

H. Fire dampers.

I. Combination fire and smoke dampers.

J. Combination fire, smoke, and control dampers.

K. Smoke dampers.

L. Gravity backdraft dampers.

M. Motorized pressure dampers.

N. Motorized backdraft dampers.

O. Insulated flexible round ductwork.

P. Flexible duct fan connections.

Q. Access door hardware.

R. Duct access doors.

S. Air Flow measuring devices.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED IN THIS SECTION

A. Outside, return, and exhaust air dampers for supply fan/return fan systems per Section 230900.

B. Sound attenuators per Section 230540.

1.3 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Division 1 – Commissioning, coordinate as required.

1.4 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Material and Methods.

B. Section 230540 - Mechanical, Sound and Vibration Control.

C. Section 230700 - Mechanical Insulation.

D. Section 230900 - Electronic Controls.

E. Section 230593 - Testing, Adjusting and Balancing.

1.5 REFERENCES AND CODE REQUIREMENTS

A. ASHRAE - Handbook 2001 Fundamentals; Chapter 34 - Duct Design.

B. ASHRAE - Handbook 2004 HVAC Systems and Equipment; Chapter 16 - Duct Construction.

C. ASTM A90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

D. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

E. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

F. ASTM A527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

G. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.

H. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

I. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

J. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

K. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
NFPA 92A - Smoke Control Systems.
NFPA 92B - Smoke Management Systems.

L. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

M. SMACNA - HVAC Duct Construction Standards.

N. SMACNA - HVAC Air Duct Leakage Test Manual

O. SMACNA - Fibrous Glass Duct Construction Standards.

P. UL 33 - Heat Responsive Links for Fire-Protection Service.

Q. UL 181 - Factory-Made Air Ducts and Connectors.

R. UL 555 - Fire Dampers and Ceiling Dampers.
UL 555S - Leakage Rated Dampers for Smoke Control Systems.

1.6 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure: Design and Construct to SMACNA 2 in. w.g. pressure class. Low pressure duct shall include: Supply duct downstream of VAV boxes, return duct, general/toilet exhaust ducts, fresh air duct, relief duct, smoke exhaust duct and combustion air duct, unless otherwise indicated on drawings.

C. Medium Pressure: Design and Construct to SMACNA 6 in. w.g. pressure class. Medium pressure duct shall include: Supply duct from supply fan(s) to VAV box inlets including built-up plenums where applicable.

1.7 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.8 SUBMITTALS

A. Submit Shop Drawings for the following items under provision of The General Conditions of the Contract:

1. Shop fabricated assemblies including duct or plenum access doors.
2. Duct fittings, particulars such as gauges, sizes, weld, and configuration prior to start of work for low pressure, kitchen hood exhaust systems.
3. Negative pressure relief dampers.

B. Submit Product Data for the following items under provision of The General Conditions of the Contract:

1. Combination fire and smoke dampers.
2. Backdraft dampers.

C. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Combination fire and smoke dampers.

1.9 PROJECT CONDITIONS

A. Contractor shall not fabricate or install any ductwork until he has assured himself that the ductwork can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

B. Contractor shall prepare 1/4" = 1'-0" scale shop drawings of all ductwork and plenums within confines of penthouse mechanical rooms for coordination with other trades and the Architectural and structural work.

C. Provide any and all off-sets and fittings required to coordinate with field conditions. The lack of coordination will not constitute a change in contract price. The contract drawings are of a schematic nature only, exact duct routing and field coordination is the responsibility of the Division 233300 Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nonmetallic air ducts and connectors shall conform to UL 181 Class 0 or Class 1.

B. Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G90 zinc coating each side in conformance with ASTM A90.

C. Aluminum Ducts: ANSI/ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.

D. Stainless Steel Ducts: ASTM A167, Type 304.

E. Fasteners: Rivets, bolts, or sheet metal screws.

F. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

G. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or all thread.

2.2 LOW PRESSURE DUCTWORK

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures specified or as indicated on drawings.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

C. Construct fittings with 45 degree wye or 90 degree wye with 45 degree entry.

D. Round take-offs shall be plain spin collar fittings of 90 degrees unless indicated otherwise on drawings.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

F. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.

G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of airflow.

2.3 MANUFACTURED DUCT JOINTS

A. Manufacturer: Ductmate Industries, Inc., TDF, MEZ Industries, Hercules, or approved equal.

B. Transverse duct joints of medium pressure ductwork shall be made with the Ductmate System components of standard catalog manufacture.

2.4 CASINGS

A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards for 2-inwg class of not less than 18 gauge panels, unless otherwise indicated on drawings.

B. At floor, rivet or bolt panels on 8 inch centers to angles.

C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection. Provide clear wire glass observation ports, minimum 6 x 8 inch size. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position. Provide a 12” x 12” viewing panel in each door with center at 4’-6” A.F.F.

D. Fabricate acoustic casings with reinforcing turned inward. Provide 16 gauge back facing in supply fan sections and elsewhere if indicated on drawings. Provide 22 gauge perforated front facing with 3/32 inch diameter holes on 5/32 inch centers. Construct panels 3 inches thick packed with 4.5 lb/cu. ft. minimum mineral wool media, on inverted channels of 16 gauge.

2.5 KITCHEN HOOD EXHAUST DUCTWORK

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and NFPA 96.

B. Construct of 16 gauge carbon steel or 18 gauge stainless steel using continuous external welded joints.

2.6 DAMPER OPERATOR HARDWARE

A. Manufacturers: Ventfabrics Ventlok Regulators, Metropolitan Air.

B. Other acceptable manufacturers offering equivalent product: Duro Dyne, Daniel.

C. Regulators and End Bearings.

Damper shaft length:
12" or less - Ventlok #620 Regulator.
12" to 20" - Ventlok #635 Regulator and #607 Bearings.
Larger dampers - Ventlok #640 or #641 Regulator and #607 Bearings.

D. Provide equivalent model elevated bases for insulated ducts.

E. Provide remote damper control where any damper does not have permanent access. System to include a locking worm drive gear, ¼” flexible steel shaft and a concealed ceiling cap of 1”. Manufacturers: Young Regulator or submitted equal.

2.7 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.

B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch.

C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 6 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

E. Provide locking, indicating quadrant regulators on single and multi-blade dampers.

F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.8 FIRE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS)
(All building supply and exhaust fans shut down upon fire and/or smoke alarm)

A. Acceptable manufacturers: Meet UL-555 requirements.

B. Furnish and install, where plans show square or rectangular fire wall penetrations, fire dampers constructed and tested in accordance with the current edition of UL-555, Standard for Fire Dampers. Each fire damper shall be marked with a UL classified 1-1/2 hour fire protection rating and "for use in static systems only." In addition each fire damper shall include a 165°F fusible link. Fire dampers shall have damper blades out of air stream for minimum airflow restriction. Fire dampers shall include a factory fabricated steel sleeve with 12" or 22" two piece picture frame mounting angles factory supplied and shipped on each damper to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. The

dampers shall be installed in accordance with manufacturer's instructions shipped with the damper. Fire dampers shall be equivalent to Ruskin model IBD2 "B" Style.

C. Where plans show round or oval fire wall penetrations, furnish and install fire dampers as described above except that fire damper shall have damper frame and blades completely out of air stream for minimum air flow restriction. Damper shall include a factory fabricated fully welded and sealed steel sleeve with 12" or 22" two piece picture frame mounting angles factory supplied and shipped on each damper to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. The dampers shall be installed in accordance with these instructions. Fire dampers shall be equivalent to Ruskin model IBD2 "CR" or "CO" Style.

D. Ducts connecting to sleeves shall be equal to or less than the sleeve thickness. Sleeve gauge requirements are listed in the SMACNA Fire, Smoke and Radiation Damper Installation Guide and outlined in NFPA 90A. If any other duct to sleeve connections are used, sleeve shall be 16 ga. minimum for dampers up 36"x24", and 14 ga. if damper width exceeds 36" or damper height exceeds 24".

E. Where job conditions require vertical dampers larger than manufacturer's maximum UL tested sizes, contractor will provide and install fire rated mullions in accordance with fire damper manufacturer's instructions.

F. Where duct gauges allow their use, contractor may, at his option, install square or rectangular fire dampers with 12, 14, 16" long integral roll-formed steel sleeves. Retaining angles shall be furnished by the damper manufacturer to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. Each fire damper shipment shall include the same UL installation instructions and the dampers shall be installed in accordance with these instructions. Fire dampers shall be Ruskin model IBD20, IBD40, or IBD60 "B" Style. Where round or oval duct gauges allow their use, contractor may, at his option, install round or oval fire dampers with 12, 14, 16" long integral roll-formed steel sleeves. Installation shall be as described above. Sleeves shall be factory sealed airtight. Fire dampers shall be equivalent to Ruskin model IBD20, IBD40, or IBD60 Style "LR" or "LO."

G. Contractor may, with engineer's approval, use certain models of dampers that afford ease of installation and labor savings such as dampers designed for grills, dampers with S-and-Drivemate breakaway connections, or dampers designed for metal stud wall applications. Install as described above per the manufacturer's UL installation instructions.

2.9 SMOKE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS)
(All building supply and exhaust fans shut down upon fire and/or smoke alarm)

A. Acceptable manufacturers: Meet UL 555S requirements.

B. Furnish and install at locations shown on plans, or as described in schedules, Ruskin model SD-60 or equivalent smoke dampers meeting or exceeding the following specifications. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped double skin construction with 14 gauge equivalent thickness. Non-airfoil blade shapes are not allowed. Blade action shall be opposed. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Galvanized or synthetic bearings are not be acceptable. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge and shall withstand a minimum of 450°F. Adhesive or clip fastened seals are not acceptable. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.

C. Each smoke damper shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems in accordance with the latest version of UL555S, and bear a UL label attesting to the same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (4 cfm/sq. ft. at 1" w.g. and 8 cfm/sq. ft. at 4" w.g.). As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and up to 4,000 fpm air velocity in the open position.

D. Each smoke damper shall be equipped with a factory supplied and mounted 120 v electric actuator to close the smoke damper during test, smoke detection, power failure.

2.10 CORRIDOR FIRE/SMOKE DAMPERS

A. Acceptable manufacturers: Meet UL requirements for a "Corridor Damper."

B. Where tunnel corridor penetrations are square or rectangular, furnish and install at locations shown on the plans or as described in schedules, corridor dampers meeting or exceeding the following specification:

C. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel and shall be low profile high performance type for lowest pressure drop. The blades shall be single skin galvanized steel 16 gauge minimum with three longitudinal grooves for reinforcement. Bearings shall be stainless steel turning in an extruded hole in frame. (Galvanized or synthetic bearings shall not be acceptable.) Blade edge seals shall be inflatable silicone coated fiberglass material to insure tight seal and low leakage. Seals shall be mechanically locked into blade edge (adhesive or clip fastened seals not acceptable) and shall withstand a minimum of 450°F. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.

D. Each damper shall be listed as a fire damper and leakage (smoke) damper and classified by Underwriters Laboratories as a "Corridor Damper" for installation in tunnel corridors. They shall be rated for 1 hour fire resistance under UL555 and shall have a minimum leakage rating of Class II under UL555S for use in smoke control systems. Each damper shall bear a UL label designating the damper as "Corridor Damper."

E. In addition to the leakage ratings already specified herein, the dampers and their non-stall type actuators shall be qualified under UL555S to an elevated temperature of 350°F. Appropriate 120v electric actuators shall be installed by the damper manufacturer at time of damper fabrication. Stall type and instantaneous close type actuators not acceptable. Damper and actuator shall be supplied as a single entity meeting all applicable UL555 and UL555S qualifications for both dampers and actuators.

F. Damper manufacturer shall provide factory assembled minimum 20 gauge steel sleeve. Damper shall be sealed to the sleeve with a 25/50 flame spread/smoke developed sealant material.

G. Each corridor damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected

to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. Damper shall be automatic remote resettable after test, smoke detection or power failure conditions. After exposure to high temperature or fire, the damper must be inspected prior to reset to ensure proper operation. Release temperatures are 165°F. 1 hour dampers shall be Ruskin model FSD36C or equivalent.

H. Where tunnel corridors use round neck diffusers, furnish and install round combination fire/smoke dampers for ceiling penetration of tunnel corridors complete with integral surface mounted ceiling diffusers, Ruskin model DFSDR or equivalent. Operation shall be the same as described above.

2.11 FIRE/SMOKE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS)
(All building supply and exhaust fans shut down upon fire and/or smoke alarm)

A. Acceptable manufacturers: Meet UL-555S requirements.

B. Furnish and install at locations shown on plans, or as described in schedules, combination fire/smoke dampers meeting or exceeding the following specifications. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped double skin construction with 14 gauge equivalent thickness. Non-airfoil blade shapes are not allowed. Blade action shall be opposed. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Galvanized or synthetic bearings are not be acceptable. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge and shall withstand a minimum of 450°F. Adhesive or clip fastened seals are not acceptable. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.

C. Each combination fire/smoke damper shall be classified 1-1/2 hour for use in fire resistance ratings of less than 3 hours or 3 hour for use for fire resistance ratings of 3 hours or more. They shall be in accordance with UL standard 555, and shall further be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems in accordance with the latest version of UL555S, and bear a UL label attesting to the same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (4 cfm/sq. ft. at 1" w.g. and 8 cfm/sq. ft. at 4" w.g.). As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and up to 4,000 fpm air velocity in the open position.

D. In addition to the leakage ratings already specified herein, the dampers and their non-stall type actuators shall be qualified under UL555S to an elevated temperature of 350°F. Appropriate 120v electric actuators shall be installed by the damper manufacturer at time of damper fabrication. Stall type and instantaneous close type actuators not acceptable. Damper and actuator shall be supplied as a single entity meeting all applicable UL555 and UL555S qualifications for both dampers and actuators. Manufacturer shall provide factory assembled sleeve of at least 17" long (contractor to verify maximum requirement). Factory supplied caulked sleeve shall be 20 gauge for dampers through 84" wide and 18 gauge for dampers above 84" wide. 12" or 22" single piece picture frame mounting angles shall be factory supplied and shipped on each

damper/sleeve assembly. Factory shall supply sleeves to accommodate square, rectangular, round, or oval ducts.

E. Each combination fire/smoke damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. Damper shall be manually resettable after activation by heat and after exposure to high temperature or fire, the damper must be inspected prior to reset to ensure proper operation. Release temperatures are 165°F. 1-1/2 hour dampers shall be Ruskin model FSD60 or equivalent and 3 hour dampers shall be Ruskin model FSD60-3 or equivalent.

2.12 GRAVITY BACKDRAFT DAMPERS (LOW VELOCITY COUNTERBALANCE TYPE) (< 2.0” w.c.)

A. Acceptable Manufacturers: Air Balance, American Warming, Arrow United (Type 655), Louvers and Dampers Inc., Prefco, Ruskin (CBD4 or CBD6), C.E. Sparrow, Airstream, Greenheck, Pottorff.

B. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.

C. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gauge galvanized steel or extruded aluminum, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.13 INSULATED FLEXIBLE ROUND DUCTWORK

A. Manufacturer: Flexmaster Type 5 - Insulated.

B. Other acceptable manufacturers offering equivalent product subject to compliance with specified requirements: Genflex, Thermaflex, Wiremold, Cleva-Flex, H.K. Porter Co., Cal-Flex, Hart & Cooley, Hercules.

C. Insulated low pressure flexible duct factory fabricated assembly consisting of a coated fiberglass fabric mechanically interlocked by a corrosion resistant metal spiral helix wrapped with nominal 1 inch thick fiberglass insulation sheathed in a vapor barrier jacket.

D. Composite assembly, including insulation and vapor barrier shall be UL Listed 181 for Class 1 Air Duct Material and comply with NFPA Standard 90A.

E. Accessories: Spin collar fittings with adjustable damper including positive locking regulator damper hardware.

2.14 FLEXIBLE DUCT FAN CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.

B. Indoor: UL listed fire-resistant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz. per sq. yd., minimum 4-inch wide, crimped into metal edging strip.

C. Outdoor: UL listed hypalon coated woven glass fabric to NFPA 90A, minimum density 24 oz. per sq. yd., minimum 4-inch wide, crimped into metal edging strip.

D. Leaded vinyl sheet, minimum 0.55 inch thick, 0.87 lbs, per sq. ft., 10 dB attenuation in 10 to 10,000 Hz range.

2.15 ACCESS DOOR HARDWARE

A. Manufacturer: Ventfabrics Ventlok Series

B. Other acceptable manufacturers offering equivalent product: Duro Dyne.

C. Latches, hinges and gasketing:

Doors less than 4 square feet - Series 100.
Doors 4 to 8 square feet - Series 200.
Larger doors and in medium pressure systems - Series 300.

2.16 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards as indicated.

B. Review locations prior to fabrication.

C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

D. Access doors smaller than 12 inches square may be secured with sash locks.

E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

F. Access doors with sheet metal screw fasteners are not acceptable.

2.17 AIRFLOW MEASURING DEVICES

A. Manufacturers: Cambridge Air Sentinel, Air Monitor Corp, Ruskin.

B. Each airflow measuring station shall measure airflow by the pitot tube traverse method. Each unit shall consist of a network of static and total pressure sensors factory positioned and connected in parallel to produce an equalized velocity pressure. The measured velocity pressure converted to air flow (cfm) shall have an accuracy within 2% of the full scale throughout the velocity range from 700 to 4000 fpm.

C. Each airflow measuring station shall consist of 16 gauge sheet metal casing, an aluminum air velocity treatment and air straightening section with an open face area of

not less than 97%, and a total and static pressure copper sensing manifold. Each station shall contain non-combustible sensors which shall be incapable of producing toxic gases or fumes in the event of elevated duct temperatures. All interconnecting tubing shall be internal to the unit with the exception of one total pressure and one static pressure meter connection.

PART 3 - EXECUTION

3.1 GENERAL SHEET METAL INSTALLATION

A. Duct sizes fall within the limiting dimensions indicated on the Drawings. Provide sheet metal duct systems, connections, dampers, duct turns, housings, hinged sheet metal doors and necessary removable access doors for the complete supply, return, and exhaust systems. Install accessories in accordance with manufacturer's instructions.

B. Seal low and medium pressure ductwork per IECC and SMACNA HVAC Air Duct Leakage Test Manual to Seal Class A. This includes all joints, seams, longitudinal, wall penetrations and transverse joints.

C. Wherever exposed ducts pass through walls, floors, or ceilings, a 2-inch flanged sheet-metal collar fitting close around ducts to be slipped along duct until flange is tight against finished surface covering edges of openings and presenting a neat appearance. Lock collar to duct.

D. Wherever ducts penetrate floors or fire walls, install safing insulation to maintain fire wall integrity.

E. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps. Permanent test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

F. Provide openings in ductwork where required to accommodate thermometers and controllers.

G. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

H. Where Bellmouth fittings are specifically called for on Drawings, provide standard Bellmouth fittings per SMACNA Standards.

I. Conduct a leakage test, per Chapter 9 of the 2006 IBC, on smoke management system ducts to 1.5 times the design pressure. Total leakage shall not exceed 5% of design flow.

J. Wherever dampers are concealed under insulation, provide marker ribbon for identification. Hang ribbon below adjacent ductwork to allow view from any angle.

3.2 SEALING OF DUCTWORK

A. Seal all ductwork to Seal Class A per SMACNA HVAC Duct Construction Standards and the most current edition of the International Energy Conservation Code (IECC). Round

runouts to VAV boxes need not be tested but require sealing to Seal Class A when installed. Additional sealing of these runouts will be required if audible air leaks are observed by the Engineer. Where joints are not accessible for proper sealing, cut hand holes in duct and seal the joints from the inside.

B. Conduct a complete duct leakage test as outlined in the most current edition of the SMACNA Air Duct Leakage Test Manual. Unless specifically noted otherwise on Drawings, testing for medium pressure ductwork upstream of VAV boxes is defined as Leakage Class 6 for rectangular ductwork and Leakage Class 3 for round or oval ductwork. Low pressure supply air ductwork downstream of VAV boxes and return air or general exhaust air ductwork is defined as Leakage Class 24 for rectangular ductwork and Leakage Class 12 for round or oval ductwork.

C. Total leakage of each duct system not to exceed recommendations in SMACNA Air Duct Leakage Test Manual per Leakage Classifications defined above. Contractor shall leak test a minimum of 15% of the medium pressure ductwork. If leakage rate exceeds maximum allowed, reseal ductwork until measured system leakage rate is less than the maximum allowable leakage rate.

3.3 MANUFACTURED DUCT JOINTS

A. The installation of the manufactured duct joints shall be in accordance with the manufacturer's printed instruction and installation manuals. Apply multiple thicknesses of butyl gasket material at each corner of rectangular duct joints to assure air tightness.

3.4 KITCHEN HOOD EXHAUST DUCTWORK

A. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout. Use stainless steel for ductwork exposed to view and stainless steel or carbon steel for ducts where concealed. Provide cleanouts and slope per code requirements.

B. Seal aluminum dishwasher exhaust ductwork watertight and slope back to dishwasher hood.

3.5 DUCTWORK APPLICATION SCHEDULE

A.

AIR SYSTEM	MATERIAL
Low Pressure Supply (Heating Systems)	Galv. Steel, Aluminum
Low Pressure Supply (System with cooling coils)	Galv. Steel, Aluminum
Medium and High Pressure Supply	Galv. Steel
Return and Relief	Galv. Steel, Aluminum
General Exhaust	Galv. Steel, Aluminum
Kitchen Hood Exhaust	Carbon Steel, Stainless Steel
Medium and High Pressure Flex Duct.	Insulated Triple Lock Aluminum
Low Pressure Flex Duct	Insulated Flexible Round Duct
Dishwasher Exhaust	Stainless Steel, Aluminum
Outside Air Intake	Galv. Steel
Combustion Air	Galv. Steel

3.6 DAMPER OPERATOR HARDWARE

A. Install per manufacturer's instructions and recommendations. Coordinate any ceiling control locations prior to installation.

B. Coordinate length of flexible shaft on site.

3.7 VOLUME CONTROL DAMPERS

A. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing.

3.8 FIRE DAMPERS, SMOKE DAMPERS AND COMBINATION FIRE/SMOKE DAMPERS

A. Provide fire dampers, combination fire and smoke dampers or smoke dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per manufacturer's instructions.

B. Demonstrate re-setting of fire/smoke dampers and/or smoke dampers to authorities having jurisdiction and Owner's representative.

3.9 GRAVITY BACKDRAFT DAMPERS (LOW PRESSURE SYSTEMS)

A. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside of building and where indicated.

B. Provide counter-balanced gravity backdraft dampers in return air duct sections from CRAC units to ceiling plenums to prevent air bypass from raised floor to ceiling space when CRAC unit fan is "off".

3.10 MOTORIZED BACKDRAFT DAMPERS

A. Provide motorized backdraft dampers where shown on drawings.

3.11 INSULATED FLEXIBLE ROUND DUCTWORK

A. Connect diffusers or troffer boots to low pressure ducts with 6 feet maximum length of flexible duct. Hold in place with strap or clamp.

B. Install flexible ducts in a fully extended condition, free of sags and kinks, using only the minimum length required to make the connection.

C. Where horizontal supports are required, suspend flexible duct on 35-inch centers with a minimum 3/4 inch wide flat bending material. Make all joints and connections with 1/2 inch wide positive locking steel straps.

D. Where "lift-out" ceilings occur, install with volume damper in flex duct at connection to main duct.

3.12 FLEXIBLE DUCT FAN CONNECTIONS

A. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Cover connections to medium and high pressure fans with leaded vinyl sheet, held in place with metal straps.

B. At least 1-inch slack shall be allowed in these connections to insure that no vibration is transmitted from fan to duct work. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage.

3.13 DUCT ACCESS DOORS

A. Provide duct access doors for inspection, maintenance and cleaning at all automatic dampers, flow station, humidifiers, fire and smoke dampers and duct turning vanes and before and after all booster coils.

B. Provide maximum 8 x 8 inch size for hand access, 24 x 24 inch size for shoulder access and as indicated.

C. Provide observation windows to see all automatic modulating dampers and fire and smoke dampers. Access doors in ducts from rated shafts to be from outside the shaft enclosure.

3.14 PRESSURE RELIEF DOORS

A. Provide pressure relief doors in accordance with manufacturer's recommendations in plenum wall between suction and discharge of plenum fans to prevent duct or plenum collapse upon failure of high pressure limit controls.

3.15 AIRFLOW MEASURING DEVICES

A. Provide airflow measuring devices where indicated in accordance with manufacturer's recommendations.

B. Coordinate control connections with Contractor for Section 230900 - Electronic Controls.

END OF SECTION 233300

SECTION 233400 - AIR HANDLING FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Cabinet Fans
B. Exhaust Fans
C. Centrifugal Fans
D. In-Line Centrifugal Fans
E. Power Roof Ventilators
F. Exhaust Fans (Ceiling Type)

1.2 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section and Contractor shall review and adhere to all requirements of these documents.

1. Section 230500 - Basic Mechanical Requirements.
2. Section 230529 - Basic Mechanical Materials and Methods.
3. Section 230540 - Mechanical Sound and Vibration Control.
4. Section 230548 - Mechanical Seismic Control.
5. Section 230593 - Testing, Adjusting and Balancing.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of specified fans with characteristics, sizes, and capacities required, whose specified fan has been in satisfactory use in similar service for not less than 3 years.

1.4 SUBMITTALS

A. Submit shop drawings and product data for the following items under provisions of the General Conditions of the Contract:

1. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details for each fan.
2. Product Data: Submit manufacturer's technical product data for all fans showing dimensions, weights, capacities, ratings, fan performance curves with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials. Provide multiple-speed performance curves for fans with variable speed drives.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. All fans.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver fans with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle fans carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to fan manufacturer.

C. Store fans in clean dry place and protect from weather and construction traffic.

D. Comply with Manufacturer's rigging and installation instructions for unloading fans and moving them to final location.

1.6 EXTRA STOCK

A. Provide one spare set of belts for each belt-driven fan.

PART 2 - PRODUCTS

2.1 CABINET FANS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide cabinet fan of one of the following: Loren Cook, Greenheck, Twin City, Trane, New York Blower, ACME, Peerless, Barry, Penn, Carnes, Breidert.

B. Furnish and install cabinet fans of size and capacity shown on drawings.

C. Cabinet shall be constructed of steel with removable panels for access to all internal parts.

D. Fan shall be double width, double inlet multi-blade centrifugal type with V-belt drive and adjustable speed sheave.

E. Fans shall be statically and dynamically balanced and shall run on permanently lubricated bearings.

F. Motor shall be provided per requirements of "Motors" in Section 230529.

2.2 CENTRIFUGAL FANS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide centrifugal fan of one of the following: Twin City, Trane, New York Blower, Pace, ACME, Cook, Barry, Carnes, Breidert.

B. Type: The fans to be backward inclined, air-foil type completely assembled with fan, fan scroll, motor, belt, drive, belt guard and motor mount, capacity and arrangement as shown on the Drawings, and certified performance tests by Air Moving and Conditioning Association (AMCA) to be submitted with the shop drawing.

C. Housing: To be constructed of steel sheet and parts to be bonderized and then coated with baked primer-finisher. The fan scroll to be attached to the side plates by means of continuous lock seam or welded seam construction.

D. Bearings: The bearings to be of the heavy-duty lubricatible type especially constructed for quiet operation, of the self-aligning, grease pack pillow block type, rated for 200,000 hours of average life.

E. Motor and Drive: To be belt driven with adjustable motor sheave. Motor nameplate horsepower shall exceed brake horsepower by a minimum of five percent. Belts to be of the oil resistant type. Motor to be especially designed for quiet operation and in accordance with "Motors" in Section 230529. Provide variable frequency drives where indicated, in accordance with Section 230810.

2.3 POWER ROOF VENTILATORS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide Power Roof Ventilator of one of the following: ACME, Jenn-Air, Penn, Greenheck, Cook, Powerline, Carnes, Twin City Fans, Breidert.

B. Furnish and install Power Roof Ventilators of model, size and capacity as shown on Drawings.

C. Housings shall be of contour, type, and material as shown on drawings.

D. Fan: Shall be the backwardly inclined type with centrifugal wheel that has been statically and dynamically balanced at the factory.

E. Motor: Shall be installed in a totally enclosed weatherproof housing outside of the air stream and in accordance with "Motors" in Section 230529.

F. Drive: Units shall be belt driven. Belt shall be oil resistant. An adjustable sheave on the motor shall be provided to allow changes in the fan speed.

G. Installation: Ventilators shall be installed on the roof on a nominal 12-inch high, pre-fabricated, self-flashing aluminum curb with 2" fiberglass insulation and metal liner, furnished with the fan.

H. Disconnect Switch: A factory wired non-fused disconnect switch shall be located under the hood of the unit.

I. Backdraft Dampers: Shall be installed on the curb of the unit unless specifically shown otherwise on the Drawings.

J. Bird Screen: Entire air outlet of the fan shall be protected by a 1/2" x 1/2" aluminum mesh securely installed in place.

2.4 EXHAUST FANS (CEILING TYPE)

A. Acceptable Manufacturer: Subject to compliance with requirements, provide ceiling type exhaust fan of one of the following: Penn Co. (Zephyr Model), ILG, Pace, Cook, Jenn-Air, Greenheck, ACME, Carnes, Twin City Fan, Broan.

B. Type: Shall be of the centrifugal fan, integral grille and housing type, all completely self-contained.

C. Capacity: Capacity and model number of the units shall be as shown on drawings, and shall be certified by AMCA.

D. Motor and Drive: Fan shall be of the direct drive type, and maximum fan motor speed shall be 1150 RPM. Motor shall be of the permanently lubricated ball bearing type, with built-in impedance or thermal overload protection, and shall be directly coupled to the fan. The motor and fan shall be easily removable thru the intake grille for service. Direct drive fans to include solid state speed controllers.

E. Housing: Shall be constructed of heavy gauge steel, and shall be completely insulated internally with acoustical insulation material to deaden sound.

F. Backdraft Damper: Each fan shall be equipped with a nonmetallic backdraft damper constructed of neoprene and shall be shatterproof under all conditions.

G. U.L. Label: Each fan shall be approved by the Underwriters' Laboratories, Inc. and shall carry the U.L. Label.

H. Intake Grille: Shall be constructed of steel frame and woven steel grille with a minimum free area of 85%. Intake grille shall have a white, factory baked enamel finish.

PART 3 – EXECUTION

3.1 INSTALLATION OF FANS

A. Install fans where indicated, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes.

B. Coordinate with other work, including ductwork, floor construction, and electrical work as necessary to interface installation of air handling equipment with other work.

C. Access: Provide access space around fans for service as indicated, but in no case less than that recommended by manufacturer.

D. Do not operate fans for any other purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

E. Support: Install floor-mounted fans on 4" high reinforced concrete pad, 6" larger on each side than unit base in accordance with Section 230529.

F. Mounting: Mount fans on vibration isolators, in accordance with manufacturer's instructions and Section 230540.

G. Seismic Restraint: Provide seismic restraints in accordance with Section 230548.

H. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer with rotation in direction indicated and intended for proper performance. If there is no rotation arrow supplied by the manufacturer, install a correct rotation arrow.

I. Duct Connections: Refer to Division 23 Air Distribution sections. Provide ductwork, accessories, and flexible connections as indicated.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of air handling equipment, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

3.3 EXTRA BELTS

A. Deliver one spare set of belts for each belt-driven fan unit, obtain receipt from Owner that belts have been received.

END OF SECTION 233400

SECTION 233713 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Registers.

C. Grilles.

D. Louvers.

E. Gravity roof hoods.

F. Goosenecks.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500- Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 230500 - Basic Mechanical Materials and Methods: Painting of ductwork visible behind outlets and inlets.

B. Section 233300 - Ductwork and Accessories.

C. Section 233600 - Air Terminal Units.

D. Section 230593 - Testing, Adjusting and Balancing.

1.4 REFERENCES

A. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

B. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

C. ARI 890-91 - Rating of Air Diffusers.

D. ASHRAE 70 - Methods of Testing for Rating the Air Flow Performance of Outlets and Inlets.

E. SMACNA - HVAC Duct Construction Standard.

F. ASTM C 636 – Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

1.5 QUALITY ASSURANCE

A. Test and rate performance of air outlets and inlets in accordance with ASHRAE 70 and ARI 890.

B. Test and rate performance of louvers in accordance with AMCA 500.

1.6 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

1.7 SUBMITTALS

A. Submit Shop Drawings for the following items under provision of The General Conditions of the Contract:

1. Shop fabricated louvers.
2. Shop fabricated roof hoods.
3. Goosenecks.

B. Submit Product Data for the following items under provision of The General Conditions of the Contract:

1. Diffusers.
2. Registers.
3. Grilles.
4. Louvers.
5. Roof hoods.

C. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.

1. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Anemostat, Barber Colman, Krueger, Carnes, Metal-Aire, Nailor-Hart, Tempo, Air Diffusion Products, Tuttle & Bailey, TurboX, Price, Hart & Cooley.

B. Diffusers are to be UL Listed and Labeled for use in fire resistive ceiling having a 3-hour or less rating.

2.2 CEILING REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Anemostat, Barber Colman, Krueger, Carnes, Metal-Aire, Nailor-Hart, Tuttle & Bailey, Price, Hart & Cooley.

2.3 CEILING SLOT DIFFUSERS (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Barber-Colman, Anemostat, Metal-Aire, Nailor-Hart, Carrier, Tempmaster, Krueger, Tuttle & Bailey.

2.4 WALL REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Metal-Aire, Barber-Colman, Anemostat, Krueger, Tuttle & Bailey, Air Concepts.

2.5 LOUVERS

A. Acceptable Manufacturers: Dowco, Airstream, Louvers and Dampers, Inc., Ruskin, Krueger, Air Balance, American Warming and Ventilating, Arrow, C. E. Sparrow, Greenheck, Cesco, Pottorff, Air-Rite.

B. Provide 6 inch deep louvers with blades on 45 degree slope with center baffle and return bend, heavy channel frame, birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.

C. Fabricate of 16 gauge galvanized steel or 12 gauge extruded aluminum, welded assembly, with factory baked enamel finish.

D. Furnish without flange for installation.

2.6 GRAVITY ROOF HOODS

A. Acceptable Manufacturers: Acme, Louvers and Dampers, Inc., Penn Ventilator, Greenheck, Ruskin, Cook.

B. Fabricate air inlet or exhaust hoods in accordance with SMACNA Low Pressure Duct Construction Standards.

C. Fabricate of galvanized steel, minimum 16 gauge base and 20 gauge hood, or aluminum, minimum 16 gauge base and 18 gauge hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake, and factory baked enamel finish.

D. Provide minimum 12 inch high insulated curb base.

E. Make hood outlet area minimum of twice throat area.

2.7 GOOSENECKS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards of minimum 18 gauge galvanized steel.

B. Mount on minimum 12 inch high curb base.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturers' instructions.

B. Install ceiling mounted items in accordance with ASTM C 636.

1. Ceiling mounted air terminals or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
2. Terminals or services weighing 20 pounds but not more than 56 pounds, in addition to the above, shall have two No. 12 gauge hangers connected from the terminal or service to the ceiling system hangers or to the structure above. These wires may be slack.
3. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.

C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black.

F. Install diffusers to ductwork with air tight connection.

G. Install duct connections to fire rated UL Listed and Labeled diffusers and return grilles in strict accordance with instructions furnished by manufacturer.

END OF SECTION 233713

SECTION 234100 - AIR CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Disposable, extended area panel filters.

B. Extended surface high efficiency media filters.

C. Filter frames.

D. Filter gauges.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements

1.3 RELATED SECTIONS

A. Section 235700 - Heat Transfer.

B. Section 237410 - Air Handling Unit With Coils.

1.4 REFERENCES

A. ANSI/UL 900 - Test Performance of Air Filter Units.

B. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

C. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components and Related Products: Performance-Test Methods.

1.5 QUALITY ASSURANCE

A. Filter media shall be ANSI/UL 900 listed, Class 1 or Class 2, as approved by local authorities.

B. Provide all filters as product of one manufacturer.

C. Assemble filter components to form filter banks from products of one manufacturer.

1.6 SUBMITTALS

A. Submit Product Data under provisions of The General Conditions of the Contract on filter media, filter performance data, filter assembly and filter frames.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Include instructions for operation, changing, and periodic cleaning.

1.7 EXTRA STOCK

A. Provide one extra set of disposable panel filters under provisions of Section 017300.

PART 2 - PRODUCTS

2.1 DISPOSABLE PANEL FILTERS

A. Acceptable Manufacturers: Cambridge, Continental, Farr, American Air Filter, ULOK Fiberbond, Flanders.

B. Media: One inch thick fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.

C. Rating: 500 FPM face velocity, 0.10 inch WG initial resistance, 0.50 inches WG recommended final resistance.

D. Casing: Cardboard frame with perforated metal retainer.

E. Holding Frames: 20 gauge minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

2.2 DISPOSABLE EXTENDED AREA PANEL FILTERS

A. Acceptable Manufacturers: Cambridge, Farr, ULOK Fiberbond, Eco Air, Flanders.

B. Media: Pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid; enclosed in cardboard frame; nominal size 24 x 24 inches x 2 inches.

C. Rating: ASHRAE 52; 25-30 percent dust spot efficiency, 90-92 percent weight arrestance; 500 FPM face velocity, 0.30 inch WG initial resistance, 1.0 inch WG recommended final resistance.

2.3 FILTER FRAMES

A. General: Fabricate filter frames and supporting structures of 16 gauge galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.

B. Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters, size for 24 x 24 inches filter media, minimum 2 inches thick; for extended surface and high efficiency particulate air filters, provide for upstream mounting of panel filters.

C. Side Servicing Housings: Flanged for insertion into ductwork, or reinforced 16 gauge galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extruded aluminum tracks or channels for primary and secondary filters with positive sealing gaskets.

2.4 FILTER GAUGES

A. Direct Reading Dial: 4-3/4 inch OD diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-1.0 inch WG, 2 percent of full scale accuracy; Magnehelic Series 2000 manufactured by Dwyer.

B. Inclined Manometer: One piece molded gray plastic with epoxy coated aluminum scale, inclined-vertical indicating tube and built-in spirit level, range 0-3 inch WG, 3 percent of full scale accuracy; Model Mark II manufactured by Dwyer.

C. Accessories: Static pressure tips with integral compression fittings, 1/4 inch aluminum tubing, 2-way or 3-way vent valves.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction.

D. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.

END OF SECTION 234100

SECTION 235100 - BREECHINGS, CHIMNEYS, STACKS, AND FLUES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. All Fuel Chimney.

B. Lined Prefabricated Chimney and Breeching.

C. Shop Fabricated Metal Breeching.

1.2 RELATED WORK

A. Requirements: Provide Breechings, Chimneys, Stacks and Flues in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

D. Section 224450 - Plumbing Equipment.

E. Section 235200 - Boilers.

F. Section 235400 - Fuel Fired Heaters.

1.3 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

ANSI/NFPA 37 - Installation and Use of Stationary Combustion Engines and Gas Turbines.

ANSI/NFPA 211 - Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances.

ANSI/UL 441 - Standard for Gas Vents.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacturer of prefabricated breeching and smokepipe, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.5 SUBMITTALS

A. Submit Shop Drawings for the following items under provisions of the General Conditions of the Contract:

1. Positive Pressure Chimney and Manifold System.
2. Lined Prefabricated Chimney and Breeching.
3. Shop Fabricated Metal Breeching.

B. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Positive Pressure Chimney and Manifold System.

PART 2 - PRODUCTS

2.1 ALL FUEL CHIMNEY

A. Acceptable Manufacturers:

Selkirk Metalbestos Model SS
United McGill Unistack
Metal-Fab PIC
Ampco VSI
Van Packer DW

B. General: Provide all stainless steel double-walled, preinsulated chimney sections, fittings, and accessories required for a complete installation in compliance with Underwriters Laboratories Standard UL 103.

C. Material: Stainless steel outer casing and couplers with minimum 1 inch thickness low K factor insulation between casing and non-corrosive stainless steel inner pipe.

D. Accessories: Provide manufacturer's standard accessory items including tees, elbows, increasers, ceiling supports, wall supports, roof supports, joist shields, insulation shields, wall spacers, anchor plates, locking bands, wall bands, collars, and roof housings as indicated and required for complete installation.

2.2 LINED PREFABRICATED CHIMNEY AND BREECHING

A. Acceptable Manufacturers:

Van-Packer Company, Beach Haven, NJ.

B. Chimney:

1. Model HT factory fabricated UL listed chimney.
2. Jackets: 11 gauge galvanized steel with welded seams.
3. Refractory Lining: Capable of withstanding 1800 degrees F continuous firing and 2000 degree F intermittent firing.

C. Breeching:

1. Straight sections, fittings, and accessories, as individual pieces or in combination lengths.
2. Provide expansion joints to accommodate anticipated movement for each specific installation.
3. Provide openings as required for temperature sensors and other items being furnished with appliance.
4. Material: Model LW/HT.
5. Flue Liner: 10 gauge carbon steel. Provide 1 inch wide flange fully welded to each end of flue to provide for bonding sections.
6. Insulation: 2 inch rigid cellular glass.
7. Insulating Bedding Material: Nonflammable, fireproof, insulating bonding material.
8. Jacket: Hydraulic setting, fiberglass reinforced compression coating.
9. Provide 8 inch wide aluminized steel drawband bonded with 4 inch compressible mineral fiber, to cover flanged joints.

D. Accessories:

1. Manufacturer's Standard Accessories: Cleanout sections, T-sections, straight sections, elbows, flashing, counterflashing, insulated thimbles, spark arrestor, and as indicated and required for complete installation.
2. Floor Supports: Manufacturer's standard 11 gauge prime painted supports with companion sections of 11 gauge galvanized steel jackets. Provide UL listed brackets to be welded to jackets, allowing for 1/2 inch expansion.
3. Gasket Material for Cleanout Door and Caps: High temperature ceramic fiber rope.
4. Gasket Material Between Sections of LW/HT Breeching: High temperature silicone sealant.
5. Joint Cement: Manufacturer's acid resistant cement.
6. Sealant: Silicone sealant; for use when flue gas temperatures will be less than 350 degrees F or pressures will be greater than 6 inches w.g.

E. Fabrication:

1. Fabricate sections, fittings, and accessories as individual pieces or in combination lengths for field handling.
2. Fabricate components with centrifugally cast lining in lengths suitable for connection with drawband. Bond refractory with calcium aluminate cement.
3. Fabricate chimneys with anchor lugs, cleanout, provision for support, expansion and contraction, T-sections, flashing and counterflashing.
4. Provide breechings with supports from building structure so as not to exceed permissible loading at appliance and chimney.

PART 3 - EXECUTION

3.1 ALL FUEL CHIMNEY

A. Install in full compliance with the terms of its listing in accordance with the Manufacturer's installation instructions. Maintain UL-Listed minimum clearances from combustibles. Assemble chimney pipe and accessories as indicated for complete installation.

3.2 LINED PREFABRICATED CHIMNEY AND BREECHING

A. Verify that preceding work is properly prepared to receive work of this section.

B. Beginning of installation means acceptance of existing conditions.

C. Coordinate breeching installation with appliance installer.

D. Make installation in accordance with Manufacturer's instructions, and Underwriters Laboratories' listing.

E. Support breeching in accordance with Manufacturer's instructions. Provide flanged and bolted inspection doors with gasket.

F. Install breeching and chimney with positive slope back to appliance, with suitable means for drainage of condensate.

G. Support chimney at bottom, roof and intermediate levels.

H. Provide properly sized barometric damper on breeching.

I. Provide chimney with fly ash screen.

END OF SECTION 235100

SECTION 235200 - BOILERS

PART 1 - GENERAL

1.1 RELATED WORK

A. Requirements: Provide Boilers in accordance with the Contract Documents.

B. Related work specified in other sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230548 – Mechanical Seismic Control
Section 230700 - Mechanical Insulation
Section 232123 - HVAC Pumps
Section 230900 - Electronic Controls
Section 230593 - Testing, Adjusting and Balancing

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to furnishing and installing the following:

1. Packaged hot water boiler system.

1.3 QUALITY ASSURANCE

A. Welder Qualifications: Welding shall be performed by an ASME Certified Welder with current certificate in accordance with ANSI B31.1 for shop and project site welding of piping work.

1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with American Welding Society (AWS) National Certified Pipe Welding Bureau (NCPWB) and American National Standards Institute (ANSI) Code Numbers B31.2, B31.9 as applicable for welding requirements.
2. Comply with American National Standards Institute (ANSI B31.1) Code for pressure piping.
3. Section I, VI, IVIII ASME.

1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. All boilers and associated equipment.

B. Test Reports: Submit certified Test Reports for the following showing compliance in accordance with the General Conditions of the Contract:

1. Boiler start-up tests.
2. Thermal efficiency tests.

C. Certificates: Before proceeding with the Work, submit to the Architect Construction Manager/General Contractor, two copies of Certification that the welding work will be done according to ANSI B31.1 by welders who have been tested and whose qualification test sheets are available, attesting to their ability to weld in accordance with Standard Procedure Specifications as established by the National Certified Pipe Welding Bureau.

D. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500.

1. All boilers and associated equipment.

1.6 WARRANTY

A. Provide under provisions of Section 230500 a five year extended warranty for the boiler pressure vessel under all normal operating conditions including operation at high temperature differentials to a maximum differential of 150 degrees F.

1.7 MAINTENANCE SERVICE

A. Manufacturer shall provide 90 days extended service after start-up plus a minimum of four service calls during the first year of building occupancy by the Owner. These calls shall be made, when required by the Owner, for the purpose of normal service, maintenance and instruction of Owner's Representative in proper operation.

PART 2 - PRODUCTS

2.1 CONDENSING BOILER

A. Description: Factory-fabricated, -assembled, and –tested, condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water heating service only.

B. Approved Manufacturers: Hydrotherm KN-10. Aerco MLX, Thermal Solutions EVC, Patterson Kelley – MACH, Hamilton-EVO, Peerless-Pure Fire, RBI, IBC, Heat Transfer Products, Camus Hydronics, Fulton, Laars.

C. Heat Exchanger: Corrosion-resistant combustion chamber designed for condensing application.

D. Burner: Natural or Propane gas (reference drawings), forced draft.

E. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.

1. Motors: Comply with requirements specified in Division 23 Section 'Motors'.

a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

F. Gas Train: Combination modulating or multi-stage gas valve with manual shut-off and pressure regulator.

G. Ignition: Spark ignition with 100 percent main valve shut-off with electronic flame supervision.

H. Casing:

1. Jacket: Sheet metal with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Baked-enamel or Powder-coated protective finish.
4. Insulation: Minimum 2-inch thick, insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.
6. Mounting base to secure boiler.

a. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Division 15 Section 'Mechanical Vibration and Seismic Controls' when mounting base is anchored to building structure.

I. Characteristics and Capacities:

1. Reference Drawings.

J. Controls:

1. Control panel to control/sequence multiple boilers, master boiler controller required. Boiler system and controls to have interface control card to building controls system to send and receive all boiler adjustments, setpoints, alarms, status, etc. to building management system, see control specification.

2.2 BOILER START-UP AND TEST REQUIREMENTS

A. At a time requested by the Installing Contractor, the boiler representative shall adjust and start boiler. Three, typewritten copies of the starting report shall be sent to the Architect/Engineer prior to final inspection for insertion into the O & M manuals, submitting a fourth copy directly to the Engineer, and shall include the following information for each boiler:

1. Temperature and pressure settings of the boiler.
2. Heating system water pressures, cold and hot.
3. Gas pressure setting.
4. Gas volume being burned.
5. Percent CO_2 and CO.

B. A component and integrated check shall be made of all controls. Factory tests do not substitute for this test. A foreman or superintendent of the Installing Division 23 Contractor familiar with the system shall also be present and witness this test.

C. Thermal efficiency shall be 90% minimum with CO2 at 7% minimum,10% maximum. Presence of greater than 100 ppm CO in flue gas or high stack temperature will require corrective action by the Contractor.

D. Contractor shall request and obtain inspection and written approval of the installation by the State Division of Labor prior to building occupancy.

PART 3 - EXECUTION

3.1 BOILER INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions. Pertinent details of the design engineer's plan shall be combined with all rules and regulations of authorities having jurisdiction. Provide adequate space as required by manufacturer for servicing including tube removal and replacement.

B. For batteries of modular boilers, the supply and return headers shall be piped in a reverse return configuration.

3.2 BOILER VENTING

A. The Contractor shall provide in accordance with Section 235100 - Breechings, Chimneys, Stacks, and Flues, common breeching for all draft hoods in accordance with recommendations of the boiler manufacturer and as shown on Drawings.

B. Condensing boilers shall have each module vented individually. The certified contractor shall install an air intake for use of outdoor air only for combustion, and an exhaust line to vent the products of combustion of each boiler module.

C. Boilers shall be vented in accordance with Section 235100 - Breechings, Chimneys, Stacks, and Flues.

3.3 BOILER WIRING

A. All electric wiring for control of boiler operation to be furnished and installed by Division 23 Contractor. All wiring to be heat and moisture resistant, minimum 105 deg.F.

B. Provide emergency boiler shut-off switch outside each boiler room door in accordance with Utah Boiler Code and ASME CDS-1.

3.4 START-UP SERVICE

A. After completion of installation the heating plant shall be test started in the presence of a representative of the boiler manufacturer and a performance chart of the step control system shall be furnished.

END OF SECTION 235200

SECTION 235550 - SOLAR ENERGY SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Solar Fluid Tubing, Fittings, and Joints.
B. Solar Fluid Valves.
C. Solar Fluid Pumps.
D. Solar Fluid Heat Exchanger.
E. Solar Collectors.
F. Thermal Storage Tank.
G. Solar Fluid.
H. Solar System Controls.
I. Solar Expansion Tanks.
J. Air Separators.
K. Air Elimination Valve.
L. Over Temperature Protection.
M. Solar System Controls.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish Differential Temperature Control to Control Section 230900 for installation and control wiring.

B. Furnish Thermistors for collectors and thermal storage tank to Control Section 230900 for installation in wells and control wiring.

1.3 RELATED WORK

A. Requirements: Provide Solar Energy Systems in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

D. Section 230700 - Mechanical Insulation.

E. Section 221430 - Plumbing Specialties.

F. Section 224450 - Plumbing Equipment.

G. Section 232113 - HVAC Piping and Specialties.

H. Section 232500 - HVAC Water Treatment.

I. Section 230900 - Controls.

J. Division 26 - Electrical Work.

1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with ASHRAE 93-77 (ANSI B198.1) Methods of Testing TO DETERMINE THE THERMAL PERFORMANCE OF SOLAR COLLECTORS.
2. Comply with latest Edition of IAPMO Uniform Solar Energy Code.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in Solar Energy Equipment with minimum of 5 years experience.

B. Installation: Contractor shall be required to submit a list of references of successful contracts showing at least three years experience installing solar energy systems specified herein.

1.6 SUBMITTALS

A. Submit Shop Drawings for the following items under provision of The General Conditions of the Contract:

1. Solar Collectors
2. Solar System Controls
3. Solar System Heat Exchanger Module

B. Submit Product Data for the following items under The General Conditions of the Contract:

1. Solar Fluid Valves & Devices
2. Solar Fluid Pumps
3. Solar Fluid Heat Exchangers
4. Solar Collectors
5. Solar Collector Mounting Hardware
6. Thermal Storage Tank
7. Solar Fluid
8. Solar Fluid Expansion Tanks
9. Air Separators
10. Automatic Air Elimination Valve
11. Over Temperature Protection
12. Solar System Controls

C. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500.

1. Solar Fluid Valves & Devices.
2. Solar Fluid Pumps.
3. Air Separators.
4. Automatic Air Elimination Valve.
5. Over Temperature Protection.
6. Solar System Controls.

D. Test Reports: Submit certified test data for the Collector assembly by an independent lab showing compliance with ASHRAE 93-77 and in accordance with General Conditions of the Contract.

1.7 WARRANTIES

A. Provide Warranties in accordance with Section 230500 and as follows:

B. Solar Collectors:

1. Provide written warranty signed by manufacturer, agreeing to replace/repair defective units where materials or workmanship failures have resulted in leakage of liquid, obstruction of liquid flow, excessive internal soiling, significant loss of efficiency, abnormal aging or deterioration of materials or finishes, or other failures of units or forms of deterioration causing units to not perform as initially required; warranty includes disconnection, removal, reinstallation and reconnection of units and replacement of solar fluid. Solar support mounting structure to be warranted for 5 years.
2. Product warranty period shall be for a period of 10 years from date of substantial completion as defined in the General Conditions of the Contract.

C. Solar Fluid Heat Exchanger (Shell and Tube):

1. Provide 3 year non-prorated full replacement warranty for shell, exchanger and components.

D. Solar Fluid Heat Exchanger (Double Wall Tube):

1. Provide 3 year non-prorated full replacement warranty for exchanger and components.

E. Tanks and Linings:

1. Provide 5 year non-prorated full replacement warranty for tanks and linings.

1.8 SOLAR FLUID MAINTENANCE SERVICE

A. Provide the services of a fully qualified Field Superintendent and technical assistance for one year warranty period. Services and assistance shall include the following:

1. A training session for the Owner's operating personnel instructing them clearly and fully on the installation, maintenance and testing of the Solar Fluid Systems.
2. A monthly technical service visit to the jobsite to make solar fluid concentration analysis on site with a refractive index measurement instrument. The Field Superintendent shall detail findings with the proper personnel in writing on proper practices and any corrective actions needed to protect the Solar Fluid Systems with the proper concentrations of glycol and inhibitors and any other specified additives.
3. Include in the analysis the amount of Inhibited Propylene Glycol to be added or diluted to obtain the correct concentration specified in this Solar Energy Systems Section 235550 for each system containing glycol.

1.9 EXTRA STOCK

A. Solar Fluid: Provide sufficient Inhibited Propylene Glycol to maintain specified concentrations in Solar Fluid Piping Systems during one year warranty period.

PART 2 - PRODUCTS

2.1 SOLAR FLUID TUBING, FITTINGS AND JOINTS

A. Solar Heating System: Provide copper tube type M with AWS Class BCup brazing and wrought fittings.

B. Drain Back System: Provide type M Copper tube with Class SnSb 95-5 solder and wrought fittings.

C. Copper tube shall conform to ASTM B-88.

D. Wrought copper and bronze solder joint fittings size 5" and smaller shall conform to ANSI B16.22.

E. Cast bronze solder joint fittings size 6" and larger shall conform to ANSI B16.18.

2.2 SOLAR FLUID VALVES

A. General:

1. Provide valves as specified herein and as indicated on the Drawings complete with accessories and attachments as required and appropriate.
2. Supply valves for proper pressure ratings determined by the system working pressures at point of use and of proper types for systems, system fluids, and functions indicated.
3. Provide like type valves of one manufacturer only unless specified otherwise.
4. Plainly and permanently mark valves with manufacturer's name or trademark, pressure rating, and flow direction when required to prevent improper installation.

B. Manufacturers:

1. The following manufacturers are acceptable providing the product to be considered is equivalent in every respect to the nomenclature provided by the specified make and model.

a. Bronze Valves: Jenkins, Powell, Stockham, Lunkenheimer, Milwaukee, Red-White, Walworth, Crane.
b. Ball Valves: Jamesbury, Worcester, Jenkins, Apollo, Powell, Dynaquip.

C. Valve Schedule:

1. Standard Bronze Valves - 150 SWP/300 WOG.

a. Gate, globe check, and drain.
b. Sizes 1/8 through 2 inches.

c. Schedule:

DRAWING CODE	G.V.	GL.V.	C.V.	D.V.
Valve Type:	Gate	Globe	Swing	Gate
Make:	Nibco	Nibco	Nibco	Nibco
Straight Threaded:	T-134	T-235Y	T-433Y	T-134-H-HC
Straight Soldered:	S-134	S-235Y	S-433Y	
Seats and Seals:	TFE	TFE	TFE	TFE

2. Ball Valve:

a. Blowout proof stem, 3 piece design.
b. Standard port ball.
c. Schedule:

Drawing Code	B.V.
Pressure, Temp. Rating:	150 wp at 375 F
Sizes/Inches	½ thru 2
Make:	Worcester
Straight Threaded:	4AATTSE
Actuator:	Lever
Seats and Seals:	TFE

3. Pressure Relief Valve

a. Schedule:

Type	Size	Make	Model	Max. Pressure
Press	¾”	Watts	174AM3	150

2.3 SOLAR FLUID PUMPS

A. Acceptable Manufacturers:

1. Taco
2. Grundfos

B. Provide in-line fluid lubricated type circulating pumps, bronze fitted construction, one piece enclosed type impeller hydraulically and dynamically balanced, stainless steel shaft with tungsten carbide shaft sleeve, and over load protection, 145 psig @ 240 deg.F rating.

C. Schedule: See Drawings.

2.4 SOLAR FLUID HEAT EXCHANGER (Double Wall Tube)

A. Acceptable Manufacturers: Novan, Noranda.

B. Provide heat exchanger with double wall copper tubes and manifolds with leak detection feature, all supported on a steel frame and enclosed in a 20 gage steel insulated jacket.

C. Schedule: See Drawings.

2.5 SOLAR COLLECTORS – ALTERNATE #3.

A. Acceptable Manufacturers: Lennox, Novan, Gulf Thermal, Raypak, U.S. Solar Corp., Solaron.

B. General: Provide manufacturer's standard or custom fabricated liquid solar collector units, of the size and shapes indicated, complying with the following requirements for materials, finishes, performances and fabrication details, complete with provisions for installation/anchoring in the positions indicated.

C. Schedule: See Drawings.

D. The flat plate collector modules from the top to the bottom in cross-section shall consist of the following layers:

1. A tempered, single glass cover plate, 1/8 inch minimum thickness, low iron content. Edges to be nested in EPDM gasket. Minimum solar transmittance of 90%.
2. An inner air space between glazing inner surface and absorber top surface.
3. An all copper absorber plate, with selective surface coating, containing copper passage ways for circulating solar fluid. Absorber plate shall be soldered, brazed or mechanically bonded to the collector fluid passages. The contact areas of the absorber plate with fluid passages shall be 50% of the exterior area of the fluid passage tube. Effective absorber area shall not be less than 91% of total frontal area. The edge and ends of the absorber panel shall be thermally insulated from the casing. Fluid passage tubes and manifold shall be pressure tested to 150 psi working pressure. Selective surface shall be black chrome over nickel substrate with a minimum absorbitivity of 0.92 and a maximum emissivity of 0.15.
4. A backside layer of high temperature insulation with material to meet the following:

    a. Minimum "U" factor 0.10 Btu/Sq. ft./deg. F for total thickness.
    b. Insulation shall withstand temperatures of up to 450 F without "outgasing" thermal resistance degradation, or creating a fire hazard.

5. Internal perimeter insulation.
6. Coated Aluminum backplate.
7. The layers shall be supported with an aluminum steel frame and covered with a backside cover plate. The exterior casing of the panel shall be sheet metal or extruded aluminum bolted, screwed or welded together, rigid enough to support total unit including glass in handling and shipping without undue deflection, and have mounting brackets at easily accessible points for ease of installation. Casing and glazing frame shall allow for removal and replacement of cover glass without removing the collector panel. Casing must be weatherproof without additional housing or flashing. Minimum condensation due to temperature changes within collector housing (and not due to rain, wind or snow) is acceptable.
8. Materials used in casing, gasketing, glazing, mounting and finishing shall not "outgas" at temperatures up to 400 deg.F. All materials and assemblies must be capable of operating over an ambient temperature range of from -40 deg.F to 130 deg.F and of -40 deg.F to 400 deg.F internal temperature range within collector casing. Collectors shall not exceed 4.5 lbs/sq. ft. of total frontal area. All collector modules shall be identical in size and appearance.

E. Mounting Provision: The sides and/or ends of the collector casing shall be designed to allow for easy mounting of collectors to support frame. Manufacturer to furnish all supports, bracing and cross-bracing to withstand 55 PSF wind (146 mph) loading from any direction.

F. If collectors of a different size are submitted, the Contractor and/or Manufacturer shall submit F-Chart data indicating equal or greater energy output than the collector specified and shown. This performance verification shall use the ASHRAE 93-77 efficiency curve and the net aperture area of the total array of the collector specified.

G. The F-Chart run shall be for a full year by months. The contractor and/or manufacturer shall provide additional structure, piping and other items necessary for a complete and working system caused by a change from the base specified collector.

2.6 THERMAL STORAGE TANKS (Domestic Hot Water Preheat)

A. Acceptable Manufacturers:

1. American Steel and Iron Works Denver, Co.
2. Western Filter Co., Denver Co.
3. Lochinvar
4. Weben-Jarco
5. Wessels
6. A.O. Smith
7. Adamson
8. Rheem

B. Provide an NSF Approved, ASME Certified and Labeled and National Board Certified vertical, NSF approved epoxy phenolic or polyamide lined, domestic hot water preheat storage tank for 150 psig working pressure. Tank manufacturer to provide tappings of sizes, type and locations required by the Contract Documents. Provide stratification baffle to guarantee 80% draw down without drop in outlet temperature.

1. Schedule: See Drawings.

C. Factory paint tank with rust inhibitor primer and finish with two coats of heat resistant black epoxy enamel.

D. Tank tappings shall be provided as detailed or appropriate, ASME welded tank flanges or nipples.

E. Provide a sensor clip for attachment of a thermistor.

F. Provide a sensor well for the installation of a thermistor.

2.7 SOLAR FLUID

A. Manufacturer: The Dow Chemical Company, Novan.

B. Product: Dowfrost, Dowtherm, NovaFlow.

C. Description: An inhibited propylene glycol that is clear and odorless.

D. Provide: In Solar Fluid Piping Systems in specified concentrations listed in Part 3 of this Section 235550.

2.8 SOLAR FLUID EXPANSION TANKS

A. Acceptable Manufacturers: Wessels, Amtrol, B & G, Taco.

B. Provide an EPDM diaphragm-type expansion tank which will accommodate the expanded solar fluid of the system generated within the operating temperature range, limiting this pressure increase at all components. It shall maintain minimum operating pressure necessary to eliminate all air. The only air in the system shall be the permanent sealed-in air cushion contained in the EPDM diaphragm-type tank. The expansion tank shall be welded steel, constructed, tested and stamped in accordance with Section VIII of the ASME Code for a working pressure of 150 psi and pre-charged to the minimum operating pressure.

C. Schedule: See Drawings.

2.9 AIR SEPARATOR

A. Acceptable Manufacturers: Amtrol, B & G, Taco.

B. Provide cast iron air separator, constructed in accordance with ASME Code (Section VIII) for a working pressure of 150 psi.

2.10 AUTOMATIC AIR ELIMINATION VALVE

A. Acceptable Manufacturers: Amtrol, B & G, Taco.

B. Provide cast iron air elimination valve with non-corrosive working parts, working pressure of 150.

C. Schedule: See Drawings.

2.11 SOLAR SYSTEM CONTROLS

A. Acceptable Manufacturers: Independent Energy, Heliotrope General.

B. Provide differential temperature controllers which have adjustable setpoint mechanisms that may be varied by manual control, internal adjustable methods, unless specified otherwise, in UL listed panel wall mounted.

C. All filled system temperature sensors shall be provided to meet the design parameters, unless otherwise specified.

D. Provide pool water temperature sensor to control solar fluid circulating pump.

E. Provide pre-heat domestic water temperature sensor to control solar fluid circulating pump.

F. Thermowells shall be provided to protect temperature sensor, and shall be made of material which will withstand corrosive and temperature effects of process being measured.

G. Thermistors and controller to be grounded per Manufacturer's requirements.

PART 3 - EXECUTION

3.1 SOLAR FLUID TUBING, FITTINGS AND JOINTS

A. General:

1. All copper tube and fittings shall be reamed and buffed prior to brazing or soldering.
2. The use of 50-50 solder of any class, for joint make-up or back-up for finishing is prohibited.
3. Refer and conform to the Copper Development Association instructions for proper preparation and actual installation practice for all brazed joints.
4. Support tube in accordance with Section 230529.
5. Slope all piping to insure complete drain down of solar fluid system during service.

3.2 INSTALLATION OF SOLAR FLUID VALVES

A. General:

1. Provide valves as shown on Contract Documents and as required for balancing and/or control of flow.
2. Provide isolation valves for maintenance and service on each piece of equipment regardless of whether or not shown on Contract Drawings.
3. Provide isolation valves for all branch line take-offs that serve more than two items of equipment.
4. Provide balancing valves for all returns and/or supplies to equipment as shown on Contract Documents.

B. Removal and Repair Provisions:

1. Provide all valves which are not accessible for repair without removal from piping with union connection immediately adjacent to valve outlet.

C. Provide ASME temperature and pressure relief valves, with full size drains extended and air gapped to approved receptor. Provide relief valves on all pressure vessels per ASME Standard.

3.3 SOLAR FLUID PUMPS

A. Install pumps in accordance with manufacturer's instructions. Provide access space around pumps for service, minimum as recommended by Manufacturer.

B. Refer to Section 230529 for motor types, characteristics, and requirements. (Install electrical devices furnished by manufacturer).

C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

D. Support piping adjacent to pump such that no weight is carried on pump casings.

E. Provide line sized gate valve and strainer on pump suction, and line sized soft seated check valve and ball valve on pump discharge.

F. Coordinate wall mounted Differential Control for pump and electrical power requirements with Division 26 Contractor in accordance with Section 230529 - Basic Mechanical Materials and Methods.

3.4 SOLAR FLUID HEAT EXCHANGER (Double Wall Tube)

A. Allow for tube (coil) pull without destruction, keep all piping and other equipment clear of coil pull area.

B. Provide dielectric connections to all units.

C. Provide thermometers and pressure gages on inlet and outlet of solar fluid piping.

D. Units shall be set to provide for complete drain down thru drain valve to be provided at low point.

E. Provide isolation valves to allow for complete unit or component removal without removal of connecting piping, locate valves adjacent and outside the union connections.

3.5 SOLAR COLLECTORS – Alternate #3

A. General: Except as otherwise indicated, install liquid solar collectors, including components required, in accordance with Manufacturer's instructions. Coordinate with Structural for mounting frame requirements and structure.

B. Locate each unit accurately in the position indicated in relation to other work. Position unit with sufficient clearance for installation of insulated piping and for normal service and maintenance, including clearance for removal.

C. Pitch units to the indicated angle, within indicated tolerances. Install shims as required. Anchor securely to supporting structure or substrate as indicated, installing Manufacturer's standard recommended support and anchorage system, designed to withstand maximum wind pressures at project site.

D. Installation of piping including hydrostatic testing of completed installation shall be in accordance with Section 232113 - HVAC Piping.

E. Replace solar collector units which leak or fail to perform as indicated, or are damaged or have broken their seals.

3.6 THERMAL STORAGE TANKS (Underground)

A. Install steel tank with anode in accordance with ANSI Z 95.1, and as shown on drawings.

B. Repair factory-applied external tank coating by touching-up those surfaces which were chipped, scratched, or damaged during transit.

C. Install tank on concrete pad with hold down straps, backfill, manholes and other accessories as specified herein and shown on Drawings.

D. Coordinate insulation requirements with Contractor for Section 230700 - Mechanical Insulation.

3.7 CLEANING OF SOLAR FLUID PIPING SYSTEMS

A. Provide for the cleaning of the Solar Fluid Piping Systems after hydrostatic tests have been completed and prior to the operating tests in accordance with Section 232500 - HVAC Water Treatment.

3.8 SOLAR FLUID

A. After each system has been cleaned and flushed as described in "CLEANING OF SOLAR FLUID PIPING SYSTEMS", it shall be filled with a solution of water and 50 percent by volume of inhibited, propylene, glycol.

B. Provide inhibited propylene glycol of type and formula specified for use in above described systems. Do not use any of the following:

1. Ethylene glycol
2. Standard automotive anti-freeze
3. Any solution with oil-base additives

3.9 SOLAR EXPANSION TANKS

A. Tank to be connected to the suction side of pump piping on the solar fluid return.

B. Provide unions and gate valves for complete isolation of the tank from the system.

3.10 AIR SEPARATOR

A. Install on pump suction side piping.

B. Provide unions and gate valves for complete isolation of the separator from the system.

C. Clean strainer after 24 hours operation and after 30 days operation.

3.11 AUTOMATIC AIR ELIMINATION VALVE

A. Install in accordance with Manufacturers recommendations as located on Drawings.

3.12 TESTING AND BALANCING

A. System shall be tested and balanced in accordance with Section 230593 - Testing, Adjusting and Balancing.

B. Pressure Tests: Before testing piping systems, remove or otherwise protect from damage, control devices, air vents and other parts which are not designed to stand pressure used in testing piping.

C. Hydrostatic Pressure: Test hydronically, piping for all services to 175 psi for at least six consecutive hours, during which time pressure shall remain constant without pumping. Subject copper joints to soap suds while under hydrostatic pressure.

3.13 SOLAR SYSTEM CONTROLS

A. General: Install system and materials in accordance with Manufacturer's instructions and roughing-in drawings, and details on Drawings. Install electrical work and use electrical products complying with requirements of applicable Division - 26 sections of these specifications. Mount controllers at convenient locations and heights.

B. Wiring: The term "wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices. Follow collector Manufacturer recommendations for collector mounted sensors.

C. Wiring System: Provide complete wiring system for electric-electronic controls. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly. Follow Manufacturers recommendations for grounding control wiring system.

D. Number-code or color-code conductors, excluding those used for local individual controls, for future identification and servicing of control system.

E. Unit-Mounted Equipment: Where control devices are indicated to be unit-mounted, ship electric relays, electric switches, valves, dampers and damper motors to unit Manufacturer for mounting and wiring at factory.

F. After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as Work of this Section.

G. Final adjustment shall be performed by specially trained personnel.

END OF SECTION 235550

SECTION 235700 - HEAT TRANSFER

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230700 - Mechanical Insulation
Section 232113 - HVAC Piping and Specialties
Section 232123 - HVAC Pumps
Section 235200 - Boilers
Section 235500 - Solar Energy Devices
Section 236400 - Refrigeration
Section 233400 - Air Handling Fans
Section 237410 – Air Handling Unit with Coils
Section 230900 - Electronic Controls
Section 230593 - Testing, Adjusting and Balancing

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to providing the following:

1. Plate Type Heat Exchanger
2. Electric Radiant Ceiling Panels
3. All contactors, relays, terminal boxes, thermostats and other electrical appurtenances for electric heat in accordance with "ELECTRIC WIRING" paragraph in Section 230529 - Basic Mechanical Materials and Methods.

1.3 QUALITY ASSURANCE

A. Quality control shall be in accordance with Section 230500 - Basic Mechanical Requirements.

1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.

1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Plate Type Heat Exchanger
2. Electric Heating Equipment

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500:

1. Plate Type Heat Exchanger
2. Electric Heating Equipment

PART 2 - PRODUCTS

2.1 PLATE/FRAME HEAT EXCHANGER

A. Furnish and install a water to water plate and frame heat exchanger, size and capacity as shown on the drawing, as manufactured by Bell & Gossett, Alfa Laval, Tranter, Moeller, Taco, Polaris, Armstrong, Patterson.

B. The exchanger shall be single pass, counter current flow, to facilitate access to the plate pack for maintenance.

C. The frame of the exchanger shall be designed to permit the future installation of 20 percent additional plates at a later date.

D. The maximum allowable pressure drop shall be as shown in the equipment schedule.

E. Plates:

1. Port holes not feeding passes between plates shall be fully gasketed and vented to the atmosphere.
2. Design of plates shall be such that metal-to-metal contact exists between adjacent plates. (Free-flow type plate exchangers are excepted from this provision).
3. If frame design includes plate support, plates shall be fully supported from the top stainless steel carrying bar and guided by only the bottom stainless steel bar with reinforced slots integral with the plate.
4. Gasket groove shall be designed so that full gasket support is provided by metal-to-metal plate contact both inboard and outboard of the gasket groove.
5. Plates shall be of one piece design, without need of additional “loose” type hanger straps.
6. Plates shall have a positioning system which will prevent them from shifting during operation and tightening of the plate pack.

F. Fixed and Movable End Frames:

1. Single pass counter-current design shall have nozzle/flange connections located in the fixed end frame.
2. End frame design shall not include stiffeners.

3. Slotted holes for compression bolts shall be uniformly distributed around the periphery of the end frame.
4. If frame design requires, the movable end frame shall be supported from the upper carrying bar by means of rollers and guided by the bottom bars.

G. Top Guide Bar:

1. A smooth surface shall be provided for the roller bearing carrying groove for the whole length of the carrying bar.
2. The carrying bar shall be designed to support 1.5 times the weight of a flooded exchanger, movable cover, compression bolts, nuts, and nozzles.

H. Supports:

1. Supports shall be furnished at the fixed end frame and at the end support. A minimum of two support plates shall be provided at the fixed end frame with anchor bolt holes in each plate.

I. Plate Gaskets:

1. Gaskets shall be positioned in a groove around the heat transfer surface and around the port holes of the plate as required.
2. Gasket and gasket groove detail shall be designed to facilitate positioning of plates. Gaskets shall be compressed to achieve a metal-to-metal contact between plates. (Free-flow type plate exchangers are excepted from this provision).
3. An adhesive compound compatible with the gasket material and having a thickness to insure bond strength between plate and gasket shall be applied to the plate gasket groove surface.
4. Gasket plate surface shall be thoroughly cleaned by means of solvent cleaning and dried before the application of the adhesive. Emery cloth or abrasive powders shall not be used to clean out the gasket grooves.
5. All gaskets except between end plates and frames shall be identical. One-piece gaskets are preferred except when specific plate designs require otherwise.
6. Relieving grooves shall be provided in the outside gasket in those locations where an internal gasket is used. The relieving grooves should be located such that no gasket-caused cross contamination of liquids can occur without external evidence.
7. The compressed plate pack dimensions shall be given on the manufacturer's assembly drawing. This dimension shall also be shown on the permanent nameplate attached to each respective heat exchanger.

J. Suitable lifting means shall be included on the frame to facilitate installation and maintenance of the exchangers.

K. Frame: The frame material is to be carbon steel, SA515 or SA516 grade 70 material unless designated differently in the equipment schedule.

L. Plates: Plate material shall be type 316 stainless steel.

M. Gaskets: Gasket materials must be selected based on fluid and temperature compatibility.

N. Hydrostatic Test: After complete assembly and before shipment, the exchanger shall be hydrostatic tested. ASME code PHE's shall be tested in accordance with the requirements of ASME Section VIII, Division 1.

2.2 ELECTRIC CABINET HEATERS AND UNIT HEATERS

A. Acceptable Manufacturers: Chromalox, Indeeco, Modine, Electromode, Sterling, Raywall, Markel, QMark.

B. Provide electric cabinet heaters and unit heaters of size and capacity as shown on Drawings.

C. Unit Cabinet: Shall be 14 gauge steel, enameled cabinet, color as selected by Architect, adjustable discharge louvers.

D. Motor and Blower Fans: Direct drive, blow-through design, two-speed motors and switch, resilient mounted. Motor and blower to be easily accessible for servicing. Bearings to be factory lubricated.

E. Electric Heating Elements: Fin-tube with helical fins with overheat protection. Unit to be furnished with thermostat for remote mounting as shown on drawings, tamperproof. Provide all contactors, relays, etc., as required. Entire unit to be U.L. approved.

F. Units to be provided with a summer-winter switch to allow operation without heat when desired. Operation as follows: Fan to be cycled by remote thermostat to maintain space temperature. Provide delay switch to keep fan from operating on call for heat until heating elements have warmed up.

PART 3 - EXECUTION

3.1 HEAT EXCHANGERS

A. Concrete Bases: Anchor heat exchanger to concrete base.

3.2 UNIT HEATERS (HORIZONTAL BLOW)

A. Unless noted otherwise, mount high as possible to give greatest headroom possible. Piping shall be as shown on the plans.

B. Protect the entire unit with a cover during construction.

C. Manufacturers data is to be observed before installation.

3.3 CABINET UNIT HEATERS

A. Install in accordance with manufacturers instructions.

B. Provide access to filters, controls, shut-off valves, etc.

END OF SECTION 235700

SECTION 236400 - REFRIGERATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Cooling Towers (Induced Draft)

B. Installation of cooling tower on supporting steel provided under Division 23

C. Solids Separator

D. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units

E. Refrigerant Piping Materials and Products

1.2 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials And Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230548 - Mechanical Seismic Control
Section 230700 - Mechanical Insulation
Section 232113 - HVAC Piping & Specialties
Section 232123 - HVAC Pumps
Section 232500 - HVAC Water Treatment
Section 230593 - Testing, Adjusting and Balancing

1.3 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Air Conditioning and Refrigeration Institute (ARI):

Standards for the following:

# 210/240 -	Unitary Air-Conditioning and Air-Source Heat Pump Equipment
# 270 -	Sound Rating of Outdoor Unitary Equipment
# 410-72 -	Plate Fin Type Refrigerant Coils
# 450 -	Water Cooled Condensers
# 460 -	Remote Mechanical-Draft Air Cooled Condensers
# 520 -	Positive Displacement Condensing Units

550/590 - Water Chilling Packages using the Vapor Compression Cycle
575 - Method of Measuring Machinery Sound within an Equipment Space

2. American National Standards Institute (ANSI):

ANSI B9.1 "Safety Code for Mechanical Refrigeration." (Also known as ANSI/ASHRAE 15).

ANSI B31.5 "Refrigeration Piping," and extend applicable lower pressure limits to pressures below 15 psig.

1.4 QUALITY ASSURANCE

A. Quality control shall be in accordance with Section 230500 - Basic Mechanical Requirements.

B. The firm installing the refrigeration piping shall have at least 3 years of successful installation experience on projects with refrigeration piping system work similar to that required for this project.

C. Brazing Qualifications: Certify operators, brazing procedures and brazers in accordance with ANSI B31.5 for shop and job-site brazing of refrigerant piping work.

1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Cooling Towers
2. Solids Separator
3. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units

B. Certificates: Before proceeding with refrigerant piping work, submit to the Architect/Engineer/Construction Manager/General Contractor two copies of Certification that brazing procedures, brazers and operators will be in accordance with ANSI B31.5.

C. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500.

1. Cooling Towers
2. Solids Separator
3. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units

PART 2 - PRODUCTS

2.1 COOLING TOWER (INDUCED DRAFT, VERTICAL DISCHARGE)

A. Acceptable Manufacturer: Baltimore Aircoil Series 3000, Marley Series NC, Evapco.

B. Furnish and install cooling tower of size and capacity shown on Drawings. Capacity rating shall be in accordance with Cooling Tower Institute Standards.

C. Cooling tower shall be constructed with heavy gauge, G235/Z700 galvanized steel angle and channel framework, with mill galvanized steel casing or with fiberglass reinforced polyester (FRP) panels. Exterior of panels to be furnished with low VOC acrylic latex finish or zinc chromatized aluminum.

D. Louvers shall be PVC integral with the fill sheet, or hot-dip galvanized steel. Louvers shall be factory installed.

E. The cold water basin shall be constructed of heavy gauge, hot-dip galvanized steel.

F. Hot water distribution basins shall be open gravity type constructed of hot-dip galvanized steel. Distribution weirs and plastic metering orifices shall be provided to assure even distribution of water over wet deck surface. Tower shall be furnished with a single inlet water connection to automatically balance and deliver water to distribution basins or with flow control valves.

G. The wet deck surface shall consist of wave-formed sheets of self-extinguishing polyvinyl chloride. It shall be noncombustible per NFPA Standard 220 and impervious to rot, decay, fungus or biological attack.

H. The drift eliminators shall be constructed of polyvinyl chloride.

I. Fan shall be heavy duty cast aluminum with either fixed pitch blades or individually adjustable pitch blades.

J. Fan shall be driven by either a one-piece multi-groove, neoprene/polyester PowerBand designed specifically for cooling tower service or through a right angle gear reducer connected to the drive motor with a non lubricated flexible driveshaft. Gearbox for driveshaft shall be suitable for use at low speeds (fan on VFD) while maintaining adequate lubrication.

K. Fan motor shall be TEAO, VFD compatible, 1800 rpm, reversible, squirrel cage, ball bearing type designed specifically for cooling tower service. Motor shall be furnished with special moisture protection on windings, shafts and bearings.

L. Access doors shall be provided for access to eliminators and plenum section. A heavy gauge, hot-dip galvanized wire fan guard shall be provided over each fan cylinder.

M. All steel components of the tower(s) shall be made from G235 galvanized steel or hot-dip galvanized with cut edges or other exposed surfaces given a protective coat of zinc-rich compound.

N. Hot water basin covers shall be furnished to eliminate the accumulation of debris in the hot water distribution basins.

O. Cooling tower shall be complete with the following:

1. Energy miser fan system.
2. Side outlet depressed sump.
3. Safety cage and ladder from grade to fan deck.
4. Internal walkway.

5. Electric basin heater.
6. Air inlet screens.
7. Vibration cutout switch.
8. Extended lube and oil fill lines with sight glass or dipstick.
9. Safety railings.
10. Electric water level control package (120/1/60).
11. Media bypass connection located above the water level.

2.2 INLINE SOLIDS SEPARATOR

A. Approved Manufacturers: Griswold, Lakos, Puroflux.

B. Furnish and install packaged solids separator system of size and capacity shown on Drawings.

C. Packaged solids separator system to consist of a centrifugal separator, basket strainer, pump, piping, gauges, starter with HOA switch, disconnect, single-point wiring panel, and control panel all mounted on a welded steel skid.

D. Separator shall remove a minimum of 97.8% of entrained solids 45 micron/325 mesh in size and heavier than 1.20 specific gravity per pass. Separator to be constructed of carbon steel with an exterior grade enamel paint. Separator to be capable of effective separation with a pressure drop of 3 psi across the unit. Solids outlet to be located on bottom of unit to allow removal of separated solids to drain.

E. Pump to be centrifugal type, capable of performance indicated on the unit schedule. Pump to be mounted on skid such that pump or motor can be removed without disassembling piping. Provide with an inline basket strainer and UL approved TEFC motor.

F. Electrical components shall be housed in a NEMA 1X enclosure with quick release latch. Enclosure to be complete with a single-point wiring panel. Electrical panel to be complete with motor starter, disconnect, and adjustable overload and short circuit protection.

G. Piping, strainer, and separator to be rated at 150 psi maximum working pressure.

H. Note that the Division 232500 Contractor will furnish a motorized ball valve to be installed on the purge outlet on the bottom of the separator. This valve will be controlled by a dedicated time schedule on the DDC control system provided by the Division 230900 Contractor. This valve will open to purge separated solids from the separator. Do not provide a separate purge timer system on the unit.

2.3 CASSETTE-STYLE COOLING-ONLY DUCTLESS DX FAN COIL SPLIT SYSTEMS WITH AIR COOLED CONDENSING UNITS

A. Acceptable Manufacturer: Carrier, Trane, York, Mitsubishi.

B. Furnish and install factory assembled cooling-only split systems of the type, size and capacity shown on the equipment schedule on the Drawings. Unit performance shall be certified in accordance with latest edition of ARI Standards 210 and 270.

C. Condensing units shall be of the packaged air cooled type as shown on the Drawings and consist of a rotary compressor, air cooled condenser and control panel completely factory wired and piped. Unit construction shall comply with ANSI B9.1 safety code, national electric code and ASME code.

D. The condensing unit shall contain sufficient refrigerant (R134, R410A or R407) for complete system and be equipped with refrigerant line fittings which permit mechanical or sweat connection. Brass service valves with fittings and gage ports shall be located on exterior of unit.

E. Compressor shall be of the welded hermetic type with internal vibration isolation and be located in an isolated section of unit.

F. Controls shall be factory wired and placed in a location readily accessible from top of unit. Compressor motor shall have both thermal and current sensitive overload devices.

G. Condenser coil shall be constructed with aluminum plate fins mechanically bonded to nonferrous tubing. Coil shall be protected by a grille. Condenser fan shall be propeller type, direct driven, and arranged for vertical air discharge. Fan motor shall be factory lubricated and internally protected.

H. Unit to be housed in a fully weatherproof housing made of galvaneal steel, zinc phosphatized, with a baked enamel finish.

I. Condensing unit must be capable of serving DX fan coil located 22 vertical feet below the condenser.

J. Fan coil to be of size and capacity indicated on the drawings. Fan coil to mount on vertical wall surface and have a maximum height of 14”.

K. Fan coil shall be complete with DX cooling coil, condensate pan and drain, direct drive fan, fan motor, filter, piping connectors, microprocessor control system, and integral thermostat. Include integral wall mounting bracket and mounting hardware.

L. Fan coil cabinet to be fully insulated for improved acoustical and thermal performance.

M. Fan coil to be configured with return air drawn in at top of front vertical face, and supply air discharged at bottom of front vertical face. Discharge to include manually adjustable horizontal and vertical deflection blades, as well as automatic motor driven vertical air sweep with on/off switch.

N. Fan coil unit to include a remote control that allows users to turn unit on/off, change setpoints, and change from fan-only to cooling mode.

O. Fan coil to connect to condensing unit for electrical power as necessary.

P. Provide the following accessories:

1. Start capacitor and relay.
2. Indoor fan relay.
3. Liquid line filter drier.
4. Low ambient kit (0°F).
5. Low voltage control transformer.
6. Device to prevent damage to compressor caused by short cycling.
7. Crankcase heater.

8. 14” high roof curb or 4” high concrete if slab on grade.
9. Factory installed starter and disconnect.

2.4 REFRIGERANT PIPING MATERIALS AND PRODUCTS

A. General:

1. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.5 Code for Refrigeration Piping where applicable, base pressure rating on refrigeration piping system on maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in refrigeration piping systems. Where more than 1 type of materials or products are indicated, selection is Installer's option.

B. Basic Pipe, Tube and Fittings:

1. Provide pipe, tube and fittings in accordance with the following:

   Tube Size 3/4" and Smaller: Copper tube.
   Wall Thickness: Type ACR, soft annealed temper.
   Fittings: Cast copper-allow for flared copper tubes, ANSI B16.26.
   Joints: Flared.
   Tube Size 7/8" through 4-1/8": Copper tube.
   Wall Thickness: Type ACR, soft annealed temper.
   Fittings: Wrought-copper, solder-joints.
   Joints: Brazed or soldered.

C. Refrigeration Valves:

1. Globe and Check Valves:

   a. Acceptable Manufacturers: Subject to compliance with requirements, provide globe and check valves of one of the following:

      Henry Valve Co.
      Parker Hannifin Corp., Refrigeration & Air-Conditioning Div.
      Sporlan Valve Co.
   b. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 deg.F (149 deg.C) temperature rating, 500 psi working pressure.
   c. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250 deg.F (121 deg.C) temperature rating, 500 psi working pressure.

2. Solenoid Valves:

   a. Acceptable Manufacturers: Subject to compliance with requirements, provide solenoid valves of one of the following:
      Alco Controls Div., Emerson Electric Co.
      Automatic Switch Co.
      Sporland Valve Co.

b. 2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, Teflon valve seat, NEMA 1 solenoid enclosure, 115 volt, 60 Hz., UL-listed, 1/2" conduit adapter, 250 deg.F (121 deg.C) temperature rating, 400 psi working pressure.

D. Refrigeration Accessories:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide refrigeration accessories of one of the following:

   Alco Controls Div., Emerson Electric Co.
   Henry Valve Co.
   Parker-Hannifin Corp., Refrigeration & Air-Conditioning Div.
   Sporlan Valve Co.
   Toxalert

2. Refrigerant Strainers: Brass shell and end connections, brazed joints, Monel screen, 100 mesh, UL listed, 350 psi working pressure.
3. Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL listed, 200 deg.F (93 deg.C) temperature rating, 500 psi working pressure.
4. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psi working pressure.
5. Evaporator Pressure Regulators: Provide corrosion-resistant, spring loaded, stainless steel springs, pressure operated, evaporator pressure regulator, in size and working pressure indicated, with copper connections.
6. Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment manufacturer for use in service indicated, UL listed.

PART 3 - EXECUTION

3.1 REFRIGERATION EQUIPMENT INSTALLATION

A. General: Comply with manufacturer's recommended installation instructions.

B. Provide sound and vibration isolation in accordance with Section 230540 - Mechanical Sound and Vibration Control.

C. Equipment manufacturer to provide labor to assemble, test, charge, start-up, calibrate, and instruct Owner's personnel in operation and maintenance.

3.2 COOLING TOWER

A. Comply with manufacturer's instructions for installation.

B. Install cooling tower on supporting steel provided under Division 23.

C. Mount and level cooling tower on isolators as specified in Section 230540 - Mechanical Sound and Vibration Control. Use steel support beams when required for mounting tower.

D. Verify fan rotation direction.

E. Balance condenser water flow to each tower and to each inlet.

F. Pipe main and overflow to floor drain or other approved receptor.

3.3 REFRIGERATION SYSTEM INSTALLATION

A. Refrigerant Piping:

1. General: Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Comply with ANSI B31 Code for Pressure Piping.
2. Piping to be kept clean and dry with factory installed caps in place until time of installation. Keep the entire system clean and dry during the installation. Piping to be straight and free of kinks, ripples, or restrictions of any kind. Bending the pipe will not be permitted. Fittings required to be of the long radius pattern except when used for oil traps.
3. Clean refrigerant piping by swabbing with dry lintless (linen) cloth, followed by refrigerant oil soaked swab. Remove excess oil by swabbing with cloth soaked in high flash point petroleum solvent, squeezed dry.
4. Pitch refrigerant piping 1" in 15 feet in direction of oil return to compressor. Provide oil traps and double risers where indicated, and where required to provide oil return.
5. Refrigeration system connections shall be of the sweat copper type properly cleaned and silver brazed with Sil-Fos or Easy-Flor solders using Handy and Harmon flux. Circulate nitrogen through tubes being soldered to eliminate the formation of copper oxide during the brazing operation.
6. Evacuation and leak test shall be made after refrigerant piping system is completed. The Contractor shall draw a vacuum on the entire system with a vacuum pump, the vacuum shall hold for 12 hours at 25 inches hg. of vacuum. The Contractor shall then break the vacuum with clean dry refrigerant, he shall then make a test with halide detector, after which he shall then draw another vacuum down to 25 in. and again break the vacuum with new clean dry refrigerant. The system shall then be fully charged with refrigerant and tested with halide detector at all joints.
7. Solder copper tube-and-fitting joints where indicated using silver-lead solder, ASTM B32, Grade 96 TS, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
8. Braze joints using American Welding Society (AWS) classification BCuP-4 for brazing filler metal. Bleed dry nitrogen through refrigerant piping during brazing operations.
9. Provide pipe hangers and supports in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Refrigerant Valves:

1. Provide refrigerant type hand valves where indicated on the Drawings and wherever required for routine servicing. Install in accordance with manufacturer's instructions. Remove accessible internal parts before soldering or brazing, replace after joints are completed.
2. Solenoid Valves: Install in refrigerant piping as indicated with stem pointing upwards. Wire in accordance with "Electric Wiring" paragraph in Section 230529 - Basic Mechanical Materials and Methods.

C. Refrigerant Accessories:

1. Liquid indicators, strainers and filter-drier: Furnish and install in each refrigerant circuit and in accessible location for service.
2. Evaporator Pressure Regulators: Install in refrigerant suction lines or evaporator outlets as indicated. Adjust, if required, for proper evaporator pressure.
3. Refrigerant Discharge Line Mufflers: Install as indicated, in horizontal or downflow portion of hot-gas lines, immediately after leaving compressor; not in riser.

D. Refrigerant Coils:

1. Mount refrigeration coils as shown on Drawings complete with drain pans and drain piping to floor drains.
2. Provide refrigeration piping with rubber sleeves to prevent vibration transmissions where piping passes thru plenum wall.

E. Equipment Connections:

1. General: Connect refrigerant piping to mechanical equipment in manner shown, and comply with equipment manufacturer's instructions where not otherwise indicated.
2. Provide flexible connections in suction and discharge lines at compressor and install valves where necessary for proper service and maintenance.
3. The oil level in the compressors to be checked or removed to achieve the correct level. The oil level to be rechecked after extended operation and adjusted accordingly.
4. Install refrigeration equipment on vibration isolation mountings in accordance with Section 230540 - Mechanical Sound and Vibration Control.

F. Dehydration and Charging System:

1. Install core in filter dryer after leak test but before evacuation.
2. Evacuate refrigerant system with vacuum pump, until temperature of 35 deg.F (2 deg.C) is indicated on vacuum dehydration indicator.
3. Provide manufacturer's recommended refrigerant charge to system to obtain optimum operating conditions.

END OF SECTION 236400

SECTION 237400 - AIR HANDLING SYSTEMS ON ROOF

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230548 - Mechanical Seismic Control
Section 230700 - Mechanical Insulation
Section 236400 - Refrigeration
Section 230900 - Controls
Section 230593 - Testing, Adjusting and Balancing

C. Work installed but furnished by others:

1. Damper motors for the rooftop evaporative cooling units.

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to providing the following:

1. Package Rooftop HVAC Units

1.3 QUALITY ASSURANCE

A. Quality control shall be in accordance with Section 230500 - Basic Requirements.

B. Unit shall be certified in accordance with UL Standard 1995, Safety Standard for Heating and Cooling Equipment.

C. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.

D. Unit shall be certified in accordance with ANSI Standard Z21.47, Gas-Fired Central Furnaces.

E. Unit Energy Efficiency Ratio (EER) shall be equal to or greater that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

F. Unit and components shall be designed, manufactured, and independently analyzed, rated, and certified to meet with the seismic compliance standards of the International Building Code, 2003 edition, Section 1621. If requested unit shall be provided with Certificate of Compliance from an independent certifying Professional Engineer clearly indicating that the unit and components meet seismic design requirements

1.4 SUBMITTALS

A. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances, and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be provided with detail for power and control systems and differentiate between factory installed and field installed wiring.

B. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics, and connection requirements. Installation, Operation, and Maintenance manual with startup requirements shall be provided.

1.5 EXTRA STOCK

A. Provide one complete extra set of filters for each air handling unit.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be shipped with doors bolted shut and outside air hood closed to prevent damage during transport and thereafter while in storage awaiting installation.

B. Installation, Operation, and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location should be followed.

C. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation, and Maintenance manual.

1.7 WARRANTY

A. Manufacturer shall provide a parts only warranty for a period of 12 months from the date of equipment startup or 18 months from the date of shipment, whichever is less. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and air filters.

PART 2 - PRODUCTS

2.1 INDIRECT FIRED MAKE-UP AIR UNITS WITH REFRIGERATED COOLING

A. Acceptable Manufacturer: Mammoth, AAON, Governair, Energy Labs, TSI.

B. Approved equal shall be acceptable if equipment includes:

1. R-410a Refrigerant
2. Direct drive supply blowers
3. Double-wall insulated cabinet construction
4. Stainless steel drain pans
5. Hinged access doors with lockable handles
6. Modulating digital scroll compressor(s) (10-100% capacity)
7. Make-up air capability (up to 100% outside air)
8. Stainless steel modulating indirect heat
9. Direct drive fans

C. Provide indirect fired make-up air unit of size and capacity shown on drawings.

D. General Description:

1. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply blowers, dampers, condenser coils, condenser fans, reheat coils, gas heaters, and unit controls.
2. Unit shall be factory assembled and tested including helium leak testing of the coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the controls compartment.
3. Unit shall have decals and tags to indicate lifting and rigging, service areas, and caution areas for safety and to assist service personnel.
4. Unit components shall be labeled, including pipe stub outs, refrigeration system components, and electrical and controls components.
5. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
6. Installation, Operation, and Maintenance manual shall be supplied within the unit.
7. Laminated color-coded wiring diagram shall match factory installed wiring and be provided in both point-to-point and ladder form and affixed to the interior of the control compartment's hinged access door.
8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

E. Construction:

1. All cabinet walls, access doors, roof, and floor shall be fabricated of rigid, impact resistant, double wall, high performance composite panels with G90 galvanized steel on both sides and a closed cell polyurethane foam interior core.
2. Foam shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F.
3. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 8 inches of positive or negative static pressure. Deflection shall be measured at the midpoint of the panel height and width.
4. Cabinet leakage rate shall not exceed 1% when tested at 6 inches of static pressure.
5. Units with cooling coils shall include double sloped 304 stainless steel drain pans and a factory provided p-trap, for field installation.
6. Roof of the air tunnel shall be sloped to provide complete drainage.
7. Unit shall have rain break overhangs above access doors.
8. Access to filters, dampers, economizers, cooling coils, controls, compressors, and heaters shall be through hinged access doors with quarter turn zinc cast lockable handles. Stainless steel hinges shall be included on the doors.

9. All openings through the base pan of the unit shall have upturned flanges of at least 0.5 inches in height around the opening through the base pan.
10. Unit shall include lifting lugs on the top of the unit.

Options:
a. Unit base pan shall be provided with 1 inch thick, 1.5 pound/cubic foot fiberglass insulation.
b. Unit shall include factory installed burglar bars on the supply and return duct connections.
c. Unit shall include factory installed painted galvanized steel condenser coil guards on the face of the condenser coil.

F. Electrical: (Options)

1. Unit shall be provided with factory installed and factory wired non-fused disconnect switch in the unit control panel.
2. Unit shall be provided with factory installed and factory wired 115V, 13 amp GFI outlet with outlet disconnect switch in the unit control panel.
3. Unit shall be provided with phase and brown out protection option which shuts down all motors in the unit if the electrical phases are more that 10% out of balance on voltage, the voltage is more that 10% under design voltage, or on phase reversal.

G. Supply Blowers:

1. Units shall include direct drive, unhoused, backward curved, plenum supply blower(s).
2. Blowers and motors shall be dynamically balanced and mounted on rubber isolators.
3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

Options:
1. Variable frequency drive(s) shall be factory wired and mounted in the unit. Blower motor(s) shall be premium efficiency.

H. Cooling Coils:

1. Evaporative Coil(s):

a. Coils shall be designed for use with R-410A (R-22) refrigerant and constructed of copper tubes with aluminum (copper) fins mechanically bonded to the tubes and galvanized (304 stainless) steel end casings. Fin design shall be sine wave rippled.
b. Coils shall have interlaced circuitry and shall be standard (6 row high) capacity.
c. Coils shall be helium leak tested.
d. Coil shall be furnished with a factory installed thermostatic expansion valve.

I. Refrigeration System:

1. Unit shall be factory charged with R-410A refrigerant.
2. Compressors shall be scroll type with thermal overload protection, independently circuited, and carry a 5 year non-prorated warranty.

3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, high performance composite panels with an R-value of 13 to prevent the transmission of noise outside the cabinet.
4. All compressors shall be digital scroll.
5. Systems shall be provided with a modulating hot gas reheat coil for leaving air temperature control.

J. Condensers:

1. Air-Cooled Condenser:

   a. Condenser fans shall be vertical discharge axial flow direct drive fans.
   b. Coils shall be designed for use with R-410A (R-22) refrigerant and constructed of copper tubes with aluminum (copper) fins mechanically bonded to the tubes and galvanized (304 stainless) steel end casings. Fin design shall be sine wave rippled
   c. Coils shall be designed for a minimum of 10 degrees of refrigerant sub-cooling.
   d. Coils shall be helium leak tested.

K. Gas Heating:

1. Unit shall include a natural gas furnace(s) with modulating stages of capacity.
2. Stainless steel heat exchanger furnaces shall carry a 25 year non-prorated warranty.
3. Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower, and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.
4. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
5. Unit shall have gas supply piping entrances in the unit base for through the curb gas piping and in the outside cabinet wall for across the roof gas piping.

Options:

1. Natural gas furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valve shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the controls compartment. On 26 and 31-70 Ton units, 540 MBtu/h gas heating assembly shall be capable of operating at any firing rate between 100% and 30% or its rated capacity, 810 MBtu/h gas heating assembly shall be capable of operating at any firing rate between 100% and 20% of its rated capacity, 1080 MBtu/h gas heating assembly shall be capable of operating at any firing rate between 100% and 15% of rated capacity.

L. Filters:

1. Unit shall include 4 inch thick pleated panel filters with an ASHRAE efficiency of 95% and a MERV rating of 13, upstream of the cooling coil. Unit shall also include 2 inch thick pleated panel pre filters with an ASHRAE efficiency of 30% and MERV rating of 7, upstream of the 4 inch standard filters.
2. Unit shall include 1 inch aluminum mesh pre filters upstream of the outside air opening.
3. Unit shall include a clogged filter switch.
4. Units shall include a Magnehelic gauge mounted in the controls compartment

M. Outside Air/Economizer: (Options)

1. Unit shall include 0-100% outside air consisting of a motor operated outside air damper constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 CFM of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Damper assembly shall be controlled by spring return. Unit shall include outside air opening bird screen, outside air hood with rain lip.

N. Controls:

1. Factory Installed and Factory Provided Controller
   a. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested.
   b. With modulating hot gas reheat option, a field installed space humidity sensor and a field installed supply air temperature sensor shall be furnished to control the amount of reheat during dehumidification. Supply air temperature and space humidity setpoint shall be field adjustable.
   c. With modulating gas heat option, a field installed supply air temperature sensor shall be furnished to control the amount of heating. Supply air temperature setpoint shall be field adjustable.
   d. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
   e. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
   f. Controller shall contain diagnostics to indicate controller power, communications, unit alarms, and sensor failures.
   g. Controller shall be capable of stand alone operation with unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available without dependence on a building management system.
   h. Make Up Air Controller
      1) Unit shall be equipped with hot gas reheat and digital scroll compressors.
      2) Outside air temperature sensor shall be factory mounted and wired. Supply air temperature sensor shall be factory wired for field installation in the supply air ductwork.

O. Accessories: (Options)

1. Unit shall be provided with a smoke detector sensing the supply air of the unit, wired to shut off the unit’s control circuit.

P. Curbs:

1. Curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit
2. Solid bottom curb shall be factory assembled and fully lined with one inch neoprene coated fiberglass insulation and include a wood nailer strip. (Curb shall be adjustable up to 3/4 inch per foot to allow for sloped roof applications.)
3. Provide seismic vibration isolation burb by Vibro-Acoustics, Kinetics, or prior approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF AIR HANDLING EQUIPMENT

A. Install air handling equipment where indicated, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes.

B. Installation, Operation, and Maintenance manual shall be supplied with the unit.

C. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation, and Maintenance manual instructions.

D. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit

E. Coordinate with other work, including ductwork, floor construction, and electrical work as necessary to interface installation of air handling equipment with other work.

F. Do not operate fans for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

G. Install units on vibration isolators or isolation bases, in accordance with Section 230540 - Mechanical Sound and Vibration Control.

3.2 ELECTRICAL CONNECTIONS

A. Ensure air handling equipment is wired properly, with rotation in direction indicated and intended for proper performance. If there is no rotation arrow supplied by the manufacturer, install a correct rotation arrow.

3.3 PACKAGED ROOFTOP HVAC UNITS

A. Install units on full perimeter support roof curbs where indicated per manufacturer's recommendations.

3.4 FIELD QUALITY CONTROL

A. Upon completion of installation of air handling equipment, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

3.5 FILTERS AND BELTS

A. Install extra set of new filters at completion of air handling system work, and prior to testing, adjusting and balancing work. Obtain receipt from Owner that new filters have been installed.

B. Deliver one spare set of belts for each belt-driven air handling unit, obtain receipt from Owner that belts have been received.

END OF SECTION 237400

SECTION 238146 – HEAT PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, all pertinent sections of Division 23 and Division 1, apply to this Section.

1.2 SCOPE OF WORK

A. Work under this Section shall include all labor, materials and equipment, inclusive of heat pumps, hanger kits and hose kits to complete the work for the space conditioning system within the building, including piping, ducting, and first year warranty labor. Work commences from, but not including, the heat exchanger transition fittings in the mechanical room. Controls and accessories such as DDC interface, 24-volt wiring and thermostats are not included in this section. This bid shall be submitted and labeled "Heat Pump Installation Bid" (HP Installation Bid).

B. This Section includes information pertinent to the following types of water-source heat pumps:

1. Water-to-Air Heat Pumps. Concealed horizontal and vertical units.

C. Related Work:

1. Motors
2. Pipe
3. Pipe Insulation

1.3 HEAT PUMP MANUFACTURER BID FORM

A. Heat Pump Cost Breakdown: Contractor to fill out and provide cost for base bid and all alternates.
The General Contract bid will be tabulated using the Column "Base Bid" total along with all other Mechanical work. (All other Mechanical items not specifically listed on this form are to be bid as specified, as listed on the Drawings, or as approved in the Addendum to the contract documents.) Prices shall be as quoted to the Contractor by the vendor, exclude sales tax.
The selected General Contractor, will provide this form complete, to the Owner within two hours after the General Contractor selection. At that time, the Mechanical Contractor's bid must include all items in all columns listed on this form. Prices shall be verified by a copy of the quotation on request.
Vendors not specifically pre-listed under alternate Columns A, B, C, D, E or "F" on this form may be submitted as a substitute by the Contractor for consideration by the Owner following procedures noted in the specification. If a column does not have a vendor pre-listed and a substitute has been pre-approved, the Mechanical Contractor may indicate the vendor providing the price. Mechanical items not specifically listed on this form, in

the Specification, on the Drawings or as approved in the Addendum to the contract documents, cannot be listed on the Mechanical Bid Breakdown.
The Owner is obligated to use items in Column "Base Bid". The Owner may elect to pick and choose from among alternative offerings in Columns A, B, C, D, E and "F" via change order. The contract shall be adjusted without markup for any price differential between the price listed in Column "Base Bid" and that listed in any selected alternative column. The Owner reserves the right to accept or reject any of the Equipment or System items anytime within ninety (90) days after signing a contract.

Specification Section	Base Bid	A Trane	B Climate Master	C Carrier	D First Co.	E Whalen Co.	F Waterfurnace
238146	$	$	$	$	$	$	$

1.4 SUBMITTALS

A. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain water-source heat pumps of the same configuration (i.e. all concealed vertical water-to-air units, etc.) through a single source from one manufacturer.

B. Product Options: Drawings indicate size, profiles and dimensional requirements for water-source heat pumps and are based on specific systems indicated.

C. Listing and Labeling: Provide electrically operated equipment specified in this Section that is listed and labeled.

1. The terms “Listed” and “Labeled” are defined in NPFA 70, Article 100.

D. Test and rate water-source heat pumps according to ISO-ARI 13256-1 GLHP (closed loop) standards.

E. ISO-ARI 13256-1 GLHP allowable variance: Unit shall meet the specified heating capacity within 5% at ISO-ARI 13256-1 GLHP conditions. In no case shall the heating capacity of the unit be less than the specified value when evaluated at 2.7 gpm/ton and an entering water temperature of 45°F. Unit must meet specified cooling capacity at ISO-ARI 13256-1 GLHP conditions.

F. Provide ISO-ARI certification. For units not rated under ISO-ARI 13256-1 GLHP, manufacturer must provide written documentation of unit performance under ISO-ARI 13256-1 GLHP conditions.

G. Supply a schedule of energy efficiency, including input watts for the total connected load both in heating and cooling modes.

H. Comply with ASHRAE 15, “Safety Code for Mechanical Refrigeration”.

I. Comply with the minimum COP/efficiency levels according to ASHRAE 90.1, “Energy Efficient Design of New Buildings Except Low-Rise Buildings”. Units under 135,000 Btu/h (cooling) must comply with ASHRAE Standard 90.1.

J. Comply with NPFA 70.

K. Comply with safety requirements of UL 484, “Room Air Conditioners”, for assembly of free-delivery water-source heat pumps.

L. Comply with safety requirements of UL 559, “Heat Pumps”, for duct system connections.

1.6 COORDINATION

A. Coordinate layout and installation of water-source heat pumps and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire suppression system components, and partition assemblies. Install heat pumps such that no lights, conduits, or other obstructions will hinder removal or service.

B. GSHP Contractor shall provide all engineering, installation, and training documentation necessary to comply with the provisions of this Section.

1.7 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Manufacturer’s warranty shall, at the minimum, provide for all unit parts for one year and the refrigeration compressor for five years.

C. Special Warranty: Installation Contractor shall submit a written warranty, executed by the contractor, agreeing to repair or replace components of water-source heat pumps that fail in materials or workmanship within the specified warranty period. The Installation Contractor shall be responsible for coordinating and implementing the manufacturer’s parts and labor warranty, (if applicable), as well as the installation warranty specified. It shall be the Installation Contractor’s responsibility to apply for any remedies included in the manufacturer’s warranty.

1. Warranty Period: The entire unit and all of its components shall maintain a warranty to fully protect the owner for one year after substantial completion of the project and five years from date of substantial completion for refrigeration circuit components.
2. Should the manufacturer offer an extended warranty, the owner needs to be notified in a timely fashion to allow the owner to take advantage of the warranty.
3. Installation Contractor must provide all freight, parts, and labor either in addition to or supplemental to any warranties associated with the manufacturer’s warranty.

PART 2 - EQUIPMENT

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide water-source heat pumps by Carrier, Climate Master, Trane/Command-Aire, Waterfurnace, First Co., Whalen Co.

2.2 HORIZONTAL OR VERTICAL

A. Description: Factory-assembled and -tested, pre-charged packaged water-source heat pumps consisting of cabinet; sealed refrigeration circuit including scroll compressor(s), water-to-refrigerant heat exchanger, refrigerant-to-air heat exchanger, and reversing valve; evaporator fan and motor assembly; refrigeration and temperature controls.

B. Cabinet: Manufacturer's standard galvanized-steel casing with the following features:

1. Access panels for inspection and access to internal components.
2. Minimum ½" thick insulation, glass fiber, meeting NFPA 90A, 1.5 lb/cu. ft. density.
3. Knockouts for electrical and piping connections.
4. Condensate drain connection.
5. Units must have the ability to be field convertible from side to back or back to side discharge with no additional parts or unit structure modification. Units will have factory-installed hanger brackets and isolation grommets.
6. Horizontal units shall have one of the following airflow arrangements: Right-Discharge/Left-Discharge/Right-Return as shown on the plans.
7. All units must have a minimum of three access panels for serviceability of compressor compartment. If other arrangements make servicing difficult, the contractor must provide access panels and clear routes to ease service. Architect must approve any changes in layout.
8. All units must have an insulated panel separating the fan compartment from the compressor compartment.
9. Units with the compressor in the airstream are not acceptable.

C. Evaporator Fan and Motor Assembly:

1. Direct- or belt-driven, DWDI forward curved fan wheel; PSC multi-speed motor with permanently lubricated bearings and thermal overload protection.
2. Unit Nominal Capacity Greater than 1 Ton: The fan shall be direct drive centrifugal forward curved type with a dynamically balanced wheel. The housing and wheel shall be designed for quiet low velocity operation. The fan housing shall be removable from the unit without disconnecting the supply air ductwork for servicing of the fan motor. The fan motor shall be an ECM-2 microprocessor controlled DC type motor with internal programming factory set for the specific unit and featuring soft start/stop and a delay off feature for maximum efficiency and quiet operation. There will further be provisions for adjusting the air delivery of the motor and blower by +/-15% from rated airflow (GS070 +0-15%).
3. Units supplied without permanently lubricated motors must provide external boilers for easy service.
4. The fan motor shall be isolated from the fan housing by torsionally flexible isolation grommets. The fan and motor assembly must be capable of overcoming the external static pressures as shown on the schedule.

D. Water-to-Refrigerant Heat Exchanger: Coaxial heat exchanger with inner copper water tube (minimum 400 psig working pressure) and outer steel refrigerant tube (minimum 450 psig working pressure). All water heat exchangers to be insulated.

E. Refrigerant-to-Air Heat Exchanger: Copper tube coil with aluminum fins with a working pressure of 450 psig.

F. Reversing Valve: Manufacturer's standard control valve designed to be fail-safe in the heating position.

G. Refrigerant Components: Units shall have a sealed refrigerant circuit including a high efficient scroll, rotary or reciprocating compressor designed for heat pump operation.

H. Refrigerant Piping Materials: Copper tube with wrought copper fittings and brazed joints. Minimum 3/8” thick flexible elastomeric insulation. Supply, return, and condensate drain connections shall be brass FPT fittings.

I. Refrigerant Metering: The equipment shall be designed to allow operation of the unit with entering fluid temperature from 25°F to 110°F.

J. Controls:

1. Controls and safety devices will be factory mounted within the unit. Controls shall include fan relay, compressor contactor, 24V transformer, reversing valve coil, and solid state lock-out controller. The lock-out controller shall include the following features: diagnostic LED’s, low pressure time delay, anti short cycle time delay, random start time delay, and one time intelligent reset. When the safety controls are activated, the lock-out circuit must reset itself the first time. Unit shall be capable of being controlled from a central Direct Digital Control system. Heat pump contractor shall coordinate with the control contractor to facilitate the field installation of the DDC controller.
2. Safety controls including a high-pressure switch, a low-pressure sensor, and a low water and low air temperature sensor. Access fittings shall be factory installed on high and low pressure refrigerant lines to facilitate field service.
3. Activation of any safety device shall prevent compressor operation via a lockout device. The lockout shall be reset at the thermostat or at the contractor-supplied disconnect switch.
4. Units which may be reset only at the disconnect switch only shall not be acceptable.
5. The standard unit controls shall interface with a heat pump (Y,O) wall thermostat (mechanical or electronic). The control system microprocessor board shall be specifically designed to protect against building electrical system noise contamination, EMI, and RFI interference. The control system shall have the following features:
   a. 50 VA transformer.
   b. Performance Monitor (PM). The PM warns when the heat pump is running inefficiently.
   c. Anti-short cycle time delay on compressor operation time delay shall be 5 minutes minimum.
   d. Random start on power up mode.
   e. Low voltage protection.
   f. High voltage protection.
   g. Unit shutdown on high or low refrigerant pressures.
   h. Unit shutdown on low water temperature.
   i. Water coil freeze protection (selectable for water or antifreeze).
   j. Air coil freeze protection (check filter switch).
   k. Option to reset unit at thermostat or disconnect. Fault type shall be retained in memory if reset at thermostat.
   l. Automatic intelligent reset. Unit shall automatically reset 5 minutes after trip if the fault has cleared. Should a fault reoccur 3 times sequentially then permanent lockout will occur.
   m. Ability to defeat time delays for servicing.
   n. Light-emitting diodes (LEDs) to indicate high pressure, low pressure, low voltage, high voltage, air/water freeze protection, condensate overflow and control status.

o. Low-pressure switch SHALL NOT be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.
p. Remote fault type indication at thermostat.
q. Selectable 24-volt or pilot duty dry contact alarm output.
r. 24-volt output to cycle a motorized water valve with compressor contactor.
s. Electric heat output to control two stages of electric heat.
t. Service test mode for troubleshooting and service.

K. Filters:

1. Units shall have a factory installed 1 in. wide filter bracket for filter removal from either side. Units shall have a 1 in. thick throwaway type fiberglass filter.
2. The contractor shall purchase one spare set of filters and replace factory shipped filters on completion of start-up.
3. Filters shall be standard sizes. If units utilize non-standard filter sizes then the contractor shall provide 12 spare filters for each unit.
4. Field installed 2 in. filter brackets and 2 in. fiberglass throwaway filters on all units can be installed by contractor.

L. Hangers: Installation Contractor must provide vibration isolation dampeners on all horizontal suspended units.

M. Installation Contractor must place all vertical units on a vibration-dampening pad.

N. Efficiency Rating: Ground source heat pumps (ISO 13256-1 GSHP) must have a minimum COP and EER to comply with ASHRAE Standard 90.1-1999 as listed on table 6.2.1B “Unitary and Applied Heat Pumps, Electrically Operated, Minimum Efficiency Requirements”. Under this standard, in the cooling mode with 77°F EWT, the heat pump must list an EER of 13.4; in the heating mode with 32°F EWT, the heat pump must list a minimum COP of 3.1. Efficiencies noted on plans supercede this requirement.

P. Additional Unit Protection: Each heat pump must be equipped with a low water temperature switch or similar device (freezestat) to prevent compressor operation at leaving fluid temperatures below 25 degrees F.

Q. Unit shall be equipped with a 75 VA-24 V transformer capable of operating a 24 V on/off solenoid valve.

R. Drain Pan: The drain pain shall be constructed to inhibit corrosion and is fully insulated. Drain outlet shall be located on pan as to allow complete and unobstructed drainage of condensate. Vertical units will be supplied with factory-installed trap inside of cabinet.

S. Controls and Safeties:

1. Electrical:

a. A control box shall be located within the unit compressor compartment and shall contain a 50 VA transformer, 24-volt activated, 2 or 3 pole compressor contactor, terminal block for thermostat wiring and solid-state controller for complete unit operation. Electro-mechanical operation is not acceptable.
b. Units shall be nameplated for use with time-delay fuses or HACR circuit breakers. Unit controls shall be 24-volt and provide heating or cooling as required by the remote thermostat/sensor.

2. Piping:

   a. Supply and return water connections shall be copper FPT fittings and shall be securely mounted flush to the cabinet corner post allowing for connection to a flexible hose without the use of a back-up wrench.
   b. All water connections and electrical knockouts must be in the compressor compartment corner post as to not interfere3 with the serviceability of unit. Contractor shall be responsible for any extra costs involved in the installation of units that do not have this feature.

T. Field-Installed Accessories:

1. Thermostat Controls:

   a. Non-programmable thermostat with 2 heat stages, 2 cool stages, auto changeover, 5-minute built-in compressor protection, locking cover included.

2. Loop Controller with six stages (2 stages for heating and 4 stages for heat rejection).
3. Filter rack (2 in.) to enhance the filtration system of the water source heat pump. NOTE: Filter rack does not include filters.
4. Fire-rated hose kits with a fixed MPT on one end and a swivel with an adapter on the other end. Hose kits can be either stainless steel or galvanized.
5. Ball valves (Brass Body) for shut-off and balancing water flow. Available with memory, with memory stop, and pressure temperature ports.
6. Y Strainers (Bronze Body) “Y” type configuration with a brass cap. Maximum operating pressure rating of 450 psi. Strainer screen made of stainless steel.
7. Solenoid Valves (Brass Body) provide slow operation for quiet system application.
8. Piping includes a ported ball valve with pressure temperature (P/T) plug ports, flexible stainless steel hose with swivel and nipple. Return hose includes a ball valve, with two P/T ports, flexible stainless steel hose with a swivel and nipple.
9. An Internet module shall be provided to enable internal and external setpoints and outputs of each unit.
10. Sheet metal pan under entire unit, water tight with sides 3” high minimum. Route ¾” drain from pan to floor sink/drain.

PART 3 – EXECUTION

- NOT USED -

END OF SECTION 238146

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Raceways.
5. Grout.
6. Common electrical installation requirements.
7. Concrete equipment bases.
8. Building wire and connectors.
9. Supporting devices for electrical components.
10. Electrical identification.
11. Electricity-metering components.
12. Cutting and patching for electrical construction.
13. Touchup painting.
14. Workmanship.
15. Coordination drawings.
16. Rough-ins.
17. Electrical installations.
18. Cutting and patching.
19. Submittals.
20. Record documents.
21. Maintenance manuals.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. PVC: Polyvinyl chloride.

D. OSHA: Occupational Safety and Health Administration.

E. NFPA: National Fire Protection Association.

F. EPA: Environmental Protection Agency

G. KW: Kilowatts.

H. NECA: National Electrical Contractor Association

I. EMT: Electrical metallic tubing.

J. FMC: Flexible metal conduit.

K. IMC: Intermediate metal conduit.

L. LFMC: Liquidtight flexible metal conduit.

M. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

B. Product Data: Follow the procedure specified in Division 1 Section “Submittals”.

C. Shop Drawings: Dimensioned plans and sections or elevation layouts of electrical-metering equipment.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

E. Additional copies may be required by individual sections of these Specifications.

F. Prepare coordination drawings in accordance with Division 1 Section “Project Coordination”, to a scale of ¼”=1’-0”, or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installation, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

5. Clearance for servicing equipment, including space for equipment disassembly required for periodic maintenance.
6. Exterior wall and foundation penetrations.
7. Fire rated wall and floor penetrations.
8. Equipment connections and support details.
9. Sizes and location of required concrete pad and bases.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

D. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

E. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

F. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

G. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

H. Verify voltage, phase and amps of all equipment, prior to rough-in phase of project.

I. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

J. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

K. Indicate the proposed locations of the major raceway systems, equipment and materials. Including the following:
1. Clearance for servicing equipment, including space for equipment disassembly required for periodic maintenance.
2. Exterior wall and foundation penetrations.
3. Fire rated wall and floor penetrations.
4. Equipment connections and support details.
5. Sizes and location of required concrete pad and bases.

1.7 WORKMANSHIP

A. All materials and equipment shall be installed in accordance with the recommendations of the manufacturer to conform to the contract documents. The installation shall be accomplished by workmen skilled in the type of work involved.

B. The Electrical Contractor shall have a licensed or certified Master Electrician assigned to direct the electrical work and to coordinate work with the General Contractor and other trades. Furthermore, a licensed or certified journeyman electrician shall be assigned to supervise the

actual performance of all electrical work under Division 26. All installers must be certified journeyman.

1. All workmen doing electrical work of any nature must at all times carry their electrician's license with them and show it upon request.

2. The licensed or certified journeyman assigned to supervise the performance of Division 26 electrical work, shall be required to be on the job site at all times, while Division 26 work is being performed.

C. The installation shall conform to the applicable rules of the National Electrical Code and National Electrical Safety Code except where more stringent requirements are noted in these specifications. Conflicts shall be brought to the attention of the Architect/Engineer.

D. The Contractor and Sub-contractors shall comply with OSHA and EPA Standards while in the performance of this contract.

1.8 SUBSTITUTIONS

A. The equipment specified carries brand names and catalog numbers and shall be interpreted as establishing a standard of quality. Use only specified items or those listed by addenda.

B. Any conflict arising from the use of substituted equipment shall be the responsibility of the supplier, who shall bear all costs required to make the equipment comply with the intent of the plans and specifications.

C. At the option of the Architect/Engineer, samples may be required for non-standard items before installation during construction.

D. No materials or apparatus shall be substituted after the bid opening except where the equipment manufacturer has been discontinued or delivery becomes a problem, then written approval of the Architect/Engineer is required.

1.9 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, indicate installed conditions for:

1. Major raceway systems, size, and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.

2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. PVC Pipe Sleeves: Schedule 40, PVC, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: As required to match the specified roof material interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

B. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

D. Right of Way: Give to piping systems installed at a required slope.

E. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 4000-psi, 28-day compressive-strength concrete and reinforcement.

3.5 FIRESTOPPING

A. Apply firestopping to penetrations of cable tray, fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.6 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality at no cost to the owner.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove demolished material from Project site.

E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

F. Contractor shall remove lamps and ballasts from the existing light fixtures and dispose them in the owner furnished containers.

3.7 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

C. Repair conduit and system that have been disturbed or broken, see 3.6B.

3.8 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:
   1. Raceways.
   2. Building wire and connectors.
   3. Supporting devices for electrical components.
   4. Electrical identification.
   5. Electricity-metering components.
   6. Concrete bases.
   7. Electrical demolition.
   8. Cutting and patching for electrical construction.
   9. Touchup painting.

B. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.
   1. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
   2. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
   3. Run the test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use a test load placement and setting that ensure continuous, safe operation.
   4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at the test load connection. Record test results.
   5. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

3.9 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."

3.10 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

B. Related Sections include the following:

1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
2. Division 26 Section “Electrical System Testing” for testing of all conductor and cables installations.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. NFPA: National Fire Prevention Association

D. ASTM: American Society for Testing and Materials

E. NEMA: National electrical Manufacturers Association

F. NETA: National Educational Telecommunications Association

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. Refer to Part 3 “Conductor Insulation and Multiconductor Cable Applications and Wiring Methods” Article for insulation type, cable construction and ratings.

C. Copper Conductors: Comply with NEMA WC 70.

D. Conductor Material: Copper complying with NEMA WC 5 stranded conductor. Aluminum conductors are allowed on this project.

E. Conductor Insulation Types: Type THHN-THWN complying with NEMA WC 5.

F. Minimum Conductor Size (power conductors): #12 AWG

G. MC-Cable or Romex cables shall not be used in this project.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

D. Conductor Material: Copper complying with NEMA WC 5 stranded conductor. Aluminum conductors are not allowed on this project.

E. Conductor Insulation Types: Type THHN-THWN complying with NEMA WC 5.

F. Minimum Conductor Size (power conductors): #12 AWG.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.138-inch thickness as indicated and of length to suit application.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: As required for the specified materials interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

C. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Stranded for all conductor sizes, unless otherwise indicated.

B. Branch Circuits: Copper. Provide solid conductors for power and lighting circuits no. 10 AWG and smaller. Provide stranded conductors for sizes no. 8 AWG and larger. All control conductors shall be THHN/THWN stranded in raceway. Motor loads shall be stranded copper..

C. Aluminum conductors are not allowed on this project.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway .

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. Fire Alarm Circuits: Type THHN-THWN, in single raceway, unless specified otherwise in Section 28, ”Digital, Addressable Fire Alarm System”.

L. Class 1 Control Circuits: Type THHN-THWN, in raceway.

M. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."

H. Clean conduits with a 95% mandrel, prior to installation of conductors.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both wall surfaces. (Public Areas)

G. Extend sleeves installed in floors 2 inches above finished floor level. (Utility Areas)

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.

2. Prior to energizing, check installed wires and cables with megaohm meter to determine insulation resistance levels to assure requirements are fulfilled.

3. Provide written documents for all Megger testing.

4. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.

5. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace malfunctioning units and retest as specified above.

D. Refer to "Commissioning Specification" sections for project commissioning requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment., plus the following special applications:
   1. Underground distribution grounding.

B. Related Sections include the following:
   1. Division 2 Section "Underground Ducts and Utility Structures" for ground test wells.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned locations of proposed grounding features specified in Part 3 "Field Quality Control" Article, including the following:
   1. Ground rods.
   2. Grounding arrangements and connections for separately derived systems.

C. Qualification Data: For testing agency and testing agency's field supervisor.

1.4 QUALITY ASSURANCE

A. Comply with UL 467 for grounding and bonding materials and equipment.

B. Comply with NFPA 70; for medium-voltage underground construction, comply with IEEE C2.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Grounding Conductors, Cables, Connectors, and Rods:
      a. Chance/Hubbell.
      b. Copperweld Corp.
      c. Erico Inc.; Electrical Products Group.
      d. Framatome Connectors/Burndy Electrical.

e. Harger Lightning Protection, Inc.
f. Heary Brothers Lightning Protection Co.
g. Kearney/Cooper Power Systems.
h. Korns: C. C. Korns Co.; Division of Robroy Industries.
i. Lyncole XIT Grounding.
j. O-Z/Gedney Co.; a business of the EGS Electrical Group.
k. Raco, Inc.; Division of Hubbell.
l. Thomas & Betts, Electrical.

2.2 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Stranded Conductors: ASTM B 8.
2. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
4. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
5. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus:
1. Rectangular bars of annealed copper, 1/4 by 2 inches by 14 inches in cross section, unless otherwise indicated; with insulators.

2.3 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

1. Non Reversible Crimps

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions required at the grounding rods.

2.4 GROUNDING ELECTRODES

A. Ground Rods: stainless steel; 3/4 inch by 10 feet in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Stranded for all conductor sizes, unless otherwise indicated.

B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

C. In raceways, use insulated equipment grounding conductors.

D. Exothermic-Welded Connections: Use for underground connections, except those at test wells.

E. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

F. Grounding Bus: Install in all electrical and all telephone equipment rooms, in rooms housing service equipment, under all raised floors and elsewhere as indicated.
   1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
   2. At doors, route the bus up to the top of the doorframe, across the top of the doorway, and down to the specified height above the floor.

G. Underground Grounding Conductors: Use tinned- copper conductor, No. #2 AWG Bare CU minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

H. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 3/0 AWG minimum or as shown on the plans.

   1. Bury at least 24 inches below grade.

I. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

   1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.

J. Conductor Terminations and Connections:

   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
   3. Connections to Structural Steel: Non Reversible Crimp.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Coordinate with Drawings and with Division 26 Section "Underground Ducts and Raceways for Electrical Systems.".

C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to

manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

E. Pad-Mounted Transformers and Switches: Install two ground rods around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install insulated equipment grounding conductors with all feeders and branch circuits.

C. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

D. Computer Outlet Circuits: Install insulated equipment-grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

E. Nonmetallic Raceways: Install an equipment-grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

F. Air-Duct Equipment Circuits: Install an equipment-grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment-grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

H. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

I. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

J. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods:
1. Drive ground rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.
2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
3. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
4. For grounding electrode system, install at least two rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
5. Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.6 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Duct Banks: Install a grounding conductor with a 50 percent ampacity of the largest phase conductor in the duct bank. (2) #4/0 AWG Bare CU minimum.

B. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 3/8 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 3/4inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

F. Support structure width shall be 24 inches (min), unless specified otherwise.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:

a. Duct entry provisions, including locations and duct sizes.
b. Frame and cover design.
c. Grounding details.
d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Qualification Data: For professional engineer and testing agency.

F. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.

3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT:
   a. Steel, set-screw type in interior/dry locations.
   b. Utilize steel, compression type in damp or exterior locations.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arnco Corporation.
2. Endot Industries Inc.
3. IPEX Inc.
4. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible type, approved for plenum installation.

2.3 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type or As indicated.

E. Finish: Manufacturer's standard enamel finish.

F. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect/Engineer.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC, “COMMUNICATION,” or as indicated for each service.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. Christy Concrete Products.
d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
e. Quazite.

2.7 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.138" thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.8 SLEEVE SEALS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.9 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit or IMC.
2. Concealed Conduit, Aboveground: Rigid steel conduit or IMC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried. Conduit bends over 22 deg. must be rigid steel including exterior lighting feeds.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
6. Minimum Raceway Size: 1-inch trade size.
7. Application of Handholes and Boxes for Underground Wiring:

a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Fiberglass enclosures with polymer-concrete frame and cover, SCTE 77, Tier 15 structural load rating.
b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer-concrete frame and cover, SCTE 77, Tier 8 structural load rating.
c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

B. Comply with the following indoor applications, unless otherwise indicated:
1. Minimum Raceway Size: 3/4-inch trade size.
2. Exposed, Not Subject to Physical Damage: EMT.
3. Exposed, Not Subject to Severe Physical Damage: EMT.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit or IMC.
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway or EMT.
8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Riser-type, optical fiber/communications cable raceway or EMT.
9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: Plenum-type, optical fiber/communications cable raceway or EMT.
10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
11. Wire Gutters: Minimum size 6” x 6” x 20”

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

D. Aluminum conduits are not permitted on project.

3.2 INSTALLATION

A. Keep raceways at least 12 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

E. Install temporary closures to prevent foreign matter from entering raceways.

F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

H. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

I. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.

J. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory long sweep on medium voltage elbows may be used in banked runs only where they can be installed parallel. This requires raceways be of the same size. In other cases provide field bends for parallel raceways.

K. Install no more than the equivalent of four 90-degree bends in any conduit run except for communications conduits, for which no more than two 90-degree bends are allowed.

L. Conceal conduit and EMT within finished walls, ceilings, and below floors, unless otherwise indicated.

M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
   1. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 100 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements. Follow the ANSI/TA/EIA-569-B standards. Conduit to end withing 12 inches of cable tray with a bend toward IDF room. Provide throat type or equal type plastic bushing.

P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; LFMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

Q. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

   1. 1-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
   2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
   3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

R. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a

blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

S. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

T. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

V. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

W. Set metal floor boxes level and flush with finished floor surface.

X. Join raceways with fittings designed and approved for that purpose and make joints tight.
1. Use insulating bushings to protect conductors.

Y. Tighten set screws of threadless fittings with suitable tools i.e Tork hand driver with foot pounds set by the factory.

Z. Set metallic floor boxes level. Trim after installation to fit flush with finished floor surface.

AA. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

BB. Run a 95% mandril through each conduit, prior to the installation of conductors. Contact the Owner’s construction coordinator to witness the pulling of mandril through each conduit. Any conduits that fail the mandril pull shall be replaced prior to installation of conductors.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows at vault entrances, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow with 3M Scotchwrap.
5. Install manufactured rigid steel conduit elbows for stub-ups at light poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.8 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes steel and aluminum cable trays and accessories.

1.3 SUBMITTALS

A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
2. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.

   a. Design Calculations: Calculate requirements for selecting seismic restraints.
   b. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

C. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:

1. Vertical and horizontal offsets and transitions.
2. Clearances for access above and to side of cable trays.
3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

D. Field quality-control reports.

E. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Aluminum cable tray may be stored outside without cover, but shall be loosely stacked, elevated off the ground, and ventilated to prevent staining during storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.
2. MONO-SYSTEMS, Inc.
3. MPHusky.
4. PW Industries.

2.2 MATERIALS AND FINISHES

A. Cable Trays, Fittings, and Accessories: Steel, complying with NEMA VE 1.
1. Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M, Class B2; with chromium-zinc, ASTM F 1136, hardware.

B. Cable Trays, Fittings, and Accessories: Aluminum, complying with NEMA VE 1, Aluminum Association's Alloy 6063-T6 for rails, rungs, and cable trays, and Alloy 5052-H32 or Alloy 6061-T6 for fabricated parts; with chromium-zinc, ASTM F 1136, splice-plate fasteners, bolts, and screws

C. Sizes and Configurations: Refer to the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

1. Width: 24” wide, unless indicated otherwise.

2. Loading depth: 4 inches.

3. Side rail: 5 inches.

4. Rung Spacing: 8 inches.

5. Ladder type rungs.

6. Maximum length: 8 feet.

7. Center-hanger supports may be used only when specifically indicated.

2.3 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 WARNING SIGNS

A. Lettering: 1-1/2-inch-high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

B. Materials and fastening are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CABLE TRAY INSTALLATION

A. Remove burrs and sharp edges from cable trays.

B. Fasten cable tray supports to building structure and install seismic restraints.

1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
2. Place supports so that spans do not exceed maximum spans on schedules.
3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
4. Support bus assembly to prevent twisting from eccentric loading.
5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
6. Locate and install supports according to NEMA VE 1.

C. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.

D. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 1. Space connectors and set gaps according to applicable standard.

E. Make changes in direction and elevation using standard fittings.

F. Brace every 8 feet. Laterally brace every 20 feet, at corner and at ends.

G. Make cable tray connections using standard fittings.

H. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

I. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

J. Workspace: Install cable trays with enough space to permit access for installing cables.

K. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

L. Locate cable tray above piping unless accessibility to cable tray is required or unless otherwise indicated.

M. Workspace: Install cable trays with sufficient space to permit access for installing cables.

N. Coordinate installation with mechanical ductwork and plumbing.

3.3 CABLE INSTALLATION

A. Install cables only when cable tray installation has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. On vertical runs, fasten cables to tray every 18 inches. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

D. Install covers after installation of cable is completed.

3.4 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.5 FIELD QUALITY CONTROL

A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:

1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

3.6 PROTECTION

A. Protect installed cable trays.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.
3. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

END OF SECTION 260536

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Refer to Section 260526 “Grounding And Bonding For Electrical Systems.”

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
2. Handholes and boxes.
3. Manholes.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

B. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for manholes, handholes, boxes, and other utility structures.
4. Warning tape.

C. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.
3. Frame and cover design and manhole frame support rings.
4. Ladder details.
5. Grounding details.
6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
7. Joint details.

D. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.

2. Cover design.
3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

E. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

F. Source quality-control test reports.

G. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

C. Provide RIGID steel 90 degree pre-manufactured elbows for all locations.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. ARNCO Corp.
2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.

8. Wausau Tile, Inc.
9. Duracrete (Phone: 801-9728686).

C. Comply with ASTM C 858 for design and manufacturing processes.

D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts manufactured by Syracuse.

a. Cover Hinges: Concealed, with hold-open ratchet assembly.
b. Cover Handle: Recessed.

E. Coordinate remaining subparagraphs and associated subparagraphs below with Drawings.

1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
2. Cover Legend: Molded lettering, "ELECTRIC."
3. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
4. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

a. Extension shall provide increased depth of 12 inches.
b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

5. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

6. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

a. Type and size shall match fittings to duct or conduit to be terminated.
b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC."
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. Christy Concrete Products.
d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
e. Quazite

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.
1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

a. Carson Industries LLC.
b. Christy Concrete Products.
c. Nordic Fiberglass, Inc.

D. High-Density Plastic Boxes: Injection molded of high-density polyethylene or copolymer-polypropylene. Cover shall be polymer concrete.
1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

a. Carson Industries LLC.
b. Nordic Fiberglass, Inc.
c. PenCell Plastics.

2.5 PRECAST MANHOLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.

6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.

B. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

a. Type and size shall match fittings to duct or conduit to be terminated.
b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.6 CAST-IN-PLACE MANHOLES

A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Materials: Comply with ASTM C 858 and with Division 03 Section "Cast-in-Place Concrete."

C. Structural Design Loading: As specified in Part 3 "Underground Enclosure Application" Article.

2.7 UTILITY STRUCTURE ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Syracuse

B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, cast aluminum with milled cover-to-frame bearing surfaces; diameter.

a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.

2. Cover Legend: Cast in. Selected to suit system.
a. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.

3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.

a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.

C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-diameter eye, and 1-by-4-inch bolt.

1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch-diameter eye, rated 2500-lbf minimum tension.

F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch-diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

I. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.

1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.
2. Arms: 1-1/2 inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 18 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

J. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

K. Fixed Manhole Ladders: Arranged for attachment to roof or wall and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from hot-dip galvanized steel.

L. PCover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

2.8 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   1. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

F. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, installed in direct-buried or concrete-encased duct bank, unless otherwise indicated.

G. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

H. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EB-20-PVC, in concrete-encased duct bank, unless otherwise indicated.

I. Underground Ducts Crossing Paved Paths, Walks and Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Polymer concrete units, SCTE 77, Tier 8, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

B. Manholes: Precast or cast-in-place concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.4 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, 12.5 feet, both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

G. Pulling Cord: Install 100-lbf-test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

   a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
   b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts, unless specified otherwise.
7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated or as indicated on the plans.
8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.

10. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
3. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete."

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
3. Install handholes with bottom below the frost line, below grade.

4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

E. Materials and fabrication: Furnish each access door assembly manufactured as integral unit, complete with all parts and ready for installation.
1. Locking Devices: Furnish flush, screwdriver-operated cam locks number required to hold door in flush smooth plane when closed.
2. Provide one cylinder lock per access door. Furnish 2 keys per lock. Key all locks alike, unless otherwise scheduled.

F. Manhole Access: Rectangular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

G. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07 Section "Elastomeric Sheet Waterproofing or Thermoplastic Sheet Waterproofing." After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

H. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Division 07 Section "Bituminous Dampproofing." After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

I. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.

J. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes, unless indicated otherwise.

K. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

L. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving or concrete slab and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi, 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep.

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

2. Pull aluminum or wood mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

B. Related Sections include the following:

1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: Coordinate with structural documents.
2. Assigned Occupancy Category as Defined in the IBC: II.

   a. Component Importance Factor: Per Structural drawings.
   b. Component Response Modification Factor: Per Structural drawings.
   c. Component Amplification Factor Per Structural drawings.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second) (S_s): per structural drawings.
4. Design Spectral Response Acceleration at 1.0-Second Period (S_1): per structural drawings.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
   a. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints. Design loads shall be determined in accordance with ASCE 7-05.

   a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:

   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of all loading scenarios determined in accordance with ASCE 7-05.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.
6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.2 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Coordinate products in this Article with structural engineer and with Drawings.

B. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

C. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.

D. Concrete Inserts: Steel-channel type.

E. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

F. Welding Lugs: Comply with MSS SP-69, Type 57.

G. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

H. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized.
3. Hot-dipped galvanize metal components for exterior use.
4. Corrosive Locations: Stainless Steel.
5. Baked enamel or powder coat for metal components on isolators for interior use.
6. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ELECTRICAL EQUIPMENT ANCHORAGE

A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.

B. Anchor panelboards, motor-control centers, motor controls, switchboards, switchgear, transformers, fused power-circuit devices, transfer switches, busways, battery racks, static uninterruptible power units, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:
1. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
2. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
3. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
4. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
5. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

C. STRUCTURAL ATTACHMENTS
1. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.
2. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.
3. Attachments to Existing Concrete: Use expansion anchors.
4. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
5. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
6. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
7. Attachments to Wood Structural Members: Install bolts through members.
8. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Remove and replace malfunctioning units and retest as specified above.

C. Testing: Test pull-out resistance of seismic anchorage devices.
1. Provide necessary test equipment required for reliable testing.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
3. Retain subparagraphs below with any paragraph selected above.
4. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
5. Obtain Architect's approval before transmitting test loads to the structure. Provide temporary load-spreading members.
6. Edit sampling frequency in subparagraph below to suit Project.
7. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
8. Test to 90 percent of rated proof load of device.
9. If a device fails the test, modify all installations of same type and retest until satisfactory results are achieved.
10. Record test results.

3.7 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.8 ELECTRICAL VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Supported or Suspended Equipment:

1. Equipment Location: as required.
2. Pads:

a. Material: Neoprene.
b. Thickness: ¼ inches.

3. Isolator Type: As designated in Part 2.
4. Component Importance Factor: Per Structural requirement..
5. Component Response Modification Factor: Per Structural requirement..
6. Component Amplification Factor: Per Structural requirement..

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products, as requested by owner.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less (see 3.1F):

1. Black letters on an orange field.
2. Legend: Indicate system or service and voltage.

C. Colors for Raceways Carrying Circuits at More Than 600 V (see 3.1F):

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high letters on 20-inch centers.

D. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch-wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape, not less than 3 mils thick by 1 to 2 inches wide. Conductors in sizes #6 and below shall be color coded with the colored insulation. Larger sizes may be identified with colored tape.

2.4 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type ID (warning tape with metal core):

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft.
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR:"
   a. Working Voltage 208V: 36 inches.
   b. Working Voltage 480V: 48 inches.
   c. Working Voltage 4160V: 60 inches.
   d. Working Voltage 12,470V: 10 feet.
   e. Working Voltage 46,000V: 10 feet.

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.8 CABLE TIES

A. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

F. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
   1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
   2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
   3. Apply the following colors to the systems listed below:

      a. Fire-Suppression Supervisory and Control System: Red and yellow.
      b. Combined Fire-Alarm and Security System: Red and blue
      c. Security System: Purple
      d. Mechanical and Electrical Supervisory System: Green and blue.
      e. Emergency power system: Yellow.
      f. 277/480 volts system: Brown.
      g. 120/208 volts system: Black.
      h. Clocks & Bells: Orange.
      i. Sound System: Green.
      j. Traveler (switch to light or switch to switch) 120 volts: Pink
      k. Traveler (switch to light or switch to switch) 277 volts: Purple
      l. Lighting control and dimmers systems: White.

G. Provide Colored raceway and couplings: Provide colored raceway for the entire length for the systems listed below:
   1. Colored coatings shall be applied over the in-line galvanized coating for the following systems listed below:
      a. Fire-Alarm: Red.
      b. Telecommunications Blue.

H. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench. Extend metal tape cable to inside transformer low voltage enclosure.

K. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

L. Circuit Identification Labels on Boxes: Install labels externally.
   1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
   2. Concealed Boxes: Plasticized card-stock tags.

3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Snap-around labels. Install labels at 10-foot maximum intervals.

C. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with color conduit. Install labels at 10-foot maximum intervals.

D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG.
b. Colors for 208/120-V Circuits:
   1) Phase A: Black.
   2) Phase B: Red.
   3) Phase C: Blue.
   4) Neutral : White
   5) Ground : Green
   6) Isolated Ground: White & Green
   7) Control: Violet
c. 480/277-V Conductors:
   1) Phase A: Brown.
   2) Phase B: Orange.
   3) Phase C: Yellow.
   4) Neutral : Gray
   5) Ground : Green
   6) Isolated Ground: White & Green
   7) Control: Violet

d. Fire Alarm-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes and enclosures, use factory colored cables and conductors to identify the individual circuits. All conductors shall be stranded.

F. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

G. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

H. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

I. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

J. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

K. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

L. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

M. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

N. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

O. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

   a. Power transfer switches.
   b. Controls with external control power connections.

P. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

Q. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

R. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved label.
b. Enclosures and electrical cabinets.
c. Switchgear.
d. Switchboards.
e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
f. Emergency system boxes and enclosures.
g. Motor-control centers.
h. Enclosed switches.
i. Enclosed circuit breakers.
j. Enclosed controllers.
k. Contactors.
l. Panelboards, electrical cabinets, and enclosures.
m. Emergency system boxes and enclosures.
n. Disconnect switches.
o. Enclosed circuit breakers.
p. Control devices.

END OF SECTION 260553

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
   1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall also be submitted in digital form.

   1. Coordination-study input data, including completed computer program input data sheets.
   2. Study and Equipment Evaluation Reports.
   3. Coordination-Study Report.
   4. Equipment setting report.
   5. Short circuit study & report.
   6. Arc fault Study & Report.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

   1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device short circuit out Arc fault study submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

    a. Circuit-breaker and fuse-current ratings and types.
    b. Relays and associated power and current transformer ratings and ratios.
    c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    d. Generator kilovolt amperes, size, voltage, and source impedance.
    e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    f. Busway ampacity and impedance.
    g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchgear and switchboard bus.
2. Medium-voltage controller.
3. Motor-control center.
4. Distribution panelboard.
5. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.

1. Transformers:

a. ANSI C57.12.10.
b. ANSI C57.12.22.
c. ANSI C57.12.40.
d. IEEE C57.12.00.
e. IEEE C57.96.

2. Medium-Voltage Circuit Breakers: IEEE C37.010.
3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

F. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram. List other output values from computer analysis, including, interrupting (5-cycle), and 30-cycle fault-current values for 3-phase, 2-phase, and phase-to-ground faults.

1. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium- and high-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

G. Equipment Evaluation Report:

1. Equipment Evaluation Report: Prepare a report on the adequacy of overcurrent protective devices and conductors by comparing fault-current ratings of these devices with calculated fault-current momentary and interrupting duties.
2. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
3. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
4. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors

at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Gather and tabulate the following input data to support coordination study:
   1. Product Data for overcurrent protective devices specified in other Division 16 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Impedance of utility service entrance.
   3. Electrical distribution system diagram showing the following:
      a. Load current that is the basis for sizing continuous ratings of circuits for cables and equipment.
      b. Circuit-breaker and fuse-current ratings and types.
      c. Relays and associated power and current transformer ratings and ratios.
      d. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
      e. Generator kilovolt amperes, size, voltage, and source impedance.
      f. Cables. Indicate conduit material, sizes of conductors, conductor insulation, and length.
      g. Busway ampacity and impedance.
      h. Motor horsepower and code letter designation according to NEMA MG 1.
   4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram:
      a. Special load considerations, including starting inrush currents and frequent starting and stopping.
      b. Magnetic inrush current overload capabilities of transformers.
      c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
      d. Ratings, types, and settings of utility company's overcurrent protective devices.
      e. Special overcurrent protective device settings or types stipulated by utility company.
      f. Time-current-characteristic curves of devices indicated to be coordinated.
      g. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
      h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
      i. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

B. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

   1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
   2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
   3. Calculate the maximum and minimum ground-fault currents.

C. Comply with NFPA 70 for overcurrent protection of circuit elements and devices.

D. Comply with IEEE 242 recommendations for fault currents and time intervals.

E. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

F. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

G. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

H. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a. Device tag.
b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
d. Fuse-current rating and type.
e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

a. Device tag.
b. Voltage and current ratio for curves.
c. Three-phase and single-phase damage points for each transformer.
d. No damage, melting, and clearing curves for fuses.
e. Cable damage curves.
f. Transformer inrush points.
g. Maximum fault-current cutoff point.

I. Completed data sheets for setting of overcurrent protective devices.

3.5 OVERCURRENT PROTECTIVE DEVICE SETTING

A. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:

1. Verify that overcurrent protective devices meet parameters used in studies.
2. Adjust devices to values listed in study results.

B. Adjust devices according to recommendations in Chapter 7, "Inspection and Test Procedures," and Tables 10.7 and 10.8 in NETA ATS.

END OF SECTION 260573

SECTION 260574 – ELECTRICAL TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general requirements for electrical field testing and inspecting. Detailed requirements are specified in each Section containing components that require testing. General requirements include the following:

1. Qualifications of testing agencies and their personnel.
2. Suitability of test equipment.
3. Calibration of test instruments.
4. Coordination requirements for testing and inspecting.
5. Reporting requirements for testing and inspecting.

B. Allowances: Electrical tests and inspections specified in various Division 23 and 26 Sections are covered by a testing and inspecting allowance specified in Division 1 Section "Allowances." See Division 1 Section "Allowances" for what is included in allowance amount, the amount of the allowance, payment procedures for allowances, changes to allowance amounts, and disposition of unused portions of allowance.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: As specified in each Section containing electrical testing requirements and in subparagraph and associated subparagraph below.

1. Independent Testing Agencies: Independent of manufacturers, suppliers, and installers of components to be tested or inspected.

a. Testing Agency's Field Supervisor for Power Component Testing: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Division 16 power component Sections.

B. Test Equipment Suitability: Comply with NETA ATS, Section 5.2.

C. Test Equipment Calibration: Comply with NETA ATS, Section 5.3.

PART 2 - NOT USED

PART 3 - EXECUTION

3.1 GENERAL TESTS AND INSPECTIONS

A. If a group of tests are specified to be performed by an independent testing agency, prepare systems, equipment, and components for tests and inspections, and perform preliminary tests to ensure that systems, equipment, and components are ready for independent agency testing. Include the following minimum preparations as appropriate:

1. Perform insulation-resistance tests in all panelboard feeders.
2. Perform continuity tests.
3. Perform rotation test (for motors to be tested).
4. Provide a stable source of single-phase, 208/120-V electrical power for test instrumentation at each test location.
5. Provide certification for main GFI.

B. Test and Inspection Reports: In addition to requirements specified elsewhere, report the following:

1. Manufacturer's written testing and inspecting instructions.
2. Calibration and adjustment settings of adjustable and interchangeable devices involved in tests.
3. Tabulation of expected measurement results made before measurements.
4. Tabulation of "as-found" and "as-left" measurement and observation results.

END OF SECTION 260574

SECTION 260800 - ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The purpose of the commissioning process is to provide the Owner/operator of the facility with a high level of assurance that the Electrical Systems have been installed in the prescribed manner, and operate within the performance guidelines set in the design intent. The Commissioning Authority shall provide the Owner with an unbiased, objective view of the systems installation, operation, and performance. This process is not to take away or reduce the responsibility of the design professionals or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The Commissioning Authority will be a member of the construction team, cooperating and coordinating all commissioning activities with the design professionals, construction manager, contractors, subcontractors, manufacturers and equipment suppliers.

1.2 SCOPE

A. The responsibilities of the Contractor shall include:

1. Coordinate and manage the Contractors commissioning activities.
2. Coordinate directly with each subcontractor and vendor with respect to their responsibilities and contractual obligations for commissioning.
3. Attend periodic on-site commissioning meetings.
4. Integrate commissioning schedule into the master construction activities schedule. Update the schedule at specified intervals..
5. Conduct installation verification inspections.
6. Review controls documentation and interface with other systems.
7. Obtain, review and assemble operation and maintenance information and as-built drawings provided by the various subcontractors and vendors.
8. Note any inconsistencies or deficiencies in system operations. Enforce system Compliance or recommend to the owners Representative modifications to system design that will correct or enhance system performance.
9. Coordinate Commissioning Authority test witnessing, after verifying that pretests have been satisfactorily conducted and final tests are ready to be performed.
10. Be present during training sessions to direct video recording, present training and direct the presentations of others.
11. Be present during start-up activities to direct and witness execution of start-up.
12. Monitor performance of testing, adjusting and other activities to ensure acceptable results, and use of approved methods and instrumentation.
13. Ensure that necessary test instrumentation is available during verification and functional performance testing, and that instruments meet quality and calibration requirements and are in good working order.

14. Be present during verification and functional performance testing and retesting to direct and witness execution of tests.
15. In the event that a commissioning test fails, determine the cause of failure, direct timely correction of the deficiency and then retest. Reimburse the Owner for billed costs for the extraordinary participation of the Owners Representative, Architect, Commissioning Authority and owner's staff.
16. Track commissioning deficiencies until correction and retesting is successfully completed.

B. The functions and responsibility of the Commissioning Authority shall include:

1. Responsibility: The primary point of responsibility is to inform the Contractor and the owner on the status, integration, and performance of systems within the facility.
2. Information: The Commissioning Authority shall function as a catalyst and initiator to disseminate information and assist the design and construction teams in the completion of the construction process. This shall include system completeness, performance, and adequacy to meet the intended performance standards of each system. Services include construction observation, spot testing, verification and functional performance testing, and providing performance and operating information to the responsible parties, e.g., contractors, design professionals, and the Owner.
3. Quality Assurance: Assist the responsible parties to maintain a high quality level of installation and system performance.
4. Observation of tests: Commissioning Authority shall observe and coordinate testing as required to ensure system performance meets the design intent.
5. Documentation of tests: Commissioning Authority shall document the results of the performance testing directly and/or ensure that all testing is documented by the appropriate technicians. The Commissioning Authority shall provide standard forms to be used by all parties for consistency of approach and type of information to be recorded.
6. Resolution of disputes: The Commissioning Authority is to remain an independent party present on the project with specific knowledge of the subject. Should disputes arise, the Commissioning Authority shall perform research to determine the scope and extent of the problem and educate the involved parties as to the nature and extent of the problem. This shall include technical and financial aspects of the dispute, including assistance to help identify who the responsible parties are and to help implement corrective action. The Owner/Architect shall preside over resolution of the problem.
7. Deficiencies: Provision of technical expertise to oversee and verify the correction of deficiencies found during the commissioning process.
8. Provision of technical expertise to review and edit operating and maintenance descriptions by system.

C. The Commissioning Agent is an independent contractor and shall work under a separate contract directly for the Owner and / or Contractor.

D. The Commissioning Agent shall not be financially associated with any entity, except the one employing him on this project, to avoid potential conflicts of interest.

1.3 SYSTEMS TO BE INCLUDED IN COMMISSIONING PROCESS

A. The following tests and verifications are to be performed by the Contractor in accordance with Section 3.4 and a written report provided to the Owner and the Commissioning Agent, and notice shall be given to the Commissioning Agent as to when the tests are to be conducted so they may be in attendance.

1. Cable trays: Visually inspect grounding connections, joints, hangers and mountings. Check for damage that may eventually result in rust or corrosion
2. Verify that all equipment is properly anchored to meet the seismic requirements detailed by the design engineer. Pay particular attention to the anchoring of floor mounted switchgear and other floor mounted devices.
3. Verify that all ground connections are tight and solid. Perform an impedance test on the grounding system.
4. Medium and High Voltage cables, capacitors, switches and switchgear, transformers, etc. are to be tested with DC or AC HI POT testers as recommended by the manufacturer and the results permanently recorded for future reference. Ground impedance for lower voltage cable and equipment is to be checked with an appropriate instrument.
5. Bus connections, cable connections, switches, transformers, etc., are to be checked with a remote reading thermometer where feasible after the equipment is in operation.
6. Verify that all motors are properly protected with properly sized disconnects (local if necessary), and that they are properly identified.
7. Verify that all communication and data cables are properly installed and tested.
9. Verify that all panel boards are properly installed, labeled and tested.
10. Verify that all receptacles, switches and other wiring devices are properly installed and tested.
11. Verify that all motor control cabinets, VFDs, etc. are properly installed and tested, and labeled.
12. Verify that all lighting systems including controls, occupancy sensors and dimmers are properly installed and tested.
14. Verify that the Fire Alarm System, the EXIT lights and the Emergency Lighting Systems are tested and approved by the proper governing authority. (i.e. Fire Marshal)
15. Verify that security systems are properly installed, labeled and tested if applicable.

1.4 COORDINATION

A. The Commissioning authority shall receive a copy of all construction documents, addenda, change orders, and appropriate approved submittals and shop drawings directly from the Architect and Contractor.

B. The Commissioning Authority shall disseminate written information and documents to all responsible parties relative to the nature and extent of the communication.

C. The Commissioning Authority is primarily responsible to his employer, and as such,

shall regularly appraise the Architect, the Contractor, and the Owner of progress, pending problems and/or disputes, and shall provide regular status reports on progress with each system. Any potential change in the contractual and/or financial obligations of the owner (credits, change orders, schedule changes, etc.) shall be identified and quantified as soon as possible.

D. The Commissioning Authority shall coordinate the schedule of commissioning activities with the construction schedule. It is possible that some procedures will be completed before the Electrical system is completed.

1.5 SCHEDULE

A. Commissioning of systems shall proceed per the criteria established, in the specific sections that follow, with activities to be performed on a timely basis. The Commissioning Authority shall be available to respond promptly to avoid construction delays.

B. Start-up and testing of systems may proceed prior to final completion of systems to expedite progress. However, the Commissioning Authority shall not perform testing and checkout services that are the primary responsibility of the contractor/vendor in advance of their testing and checkout.

C. Problems observed shall be addressed immediately, responsible parties notified, and actions to correct deficiencies coordinated in a timely manner.

D. Contractor schedules and scheduling is the responsibility of the Contractor. The Commissioning Authority shall provide commissioning scheduling information to the Contractor for review and planning activities.

1.6 RELATED WORK SPECIFIED ELSEWHERE

A. Commissioning requires support from the contractors. The commissioning process does not relieve any contractors from their obligations to complete all portions of work in a satisfactory manner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COMMISSIONING PLAN AND SCHEDULE

A. The Commissioning Authority shall develop and submit a schedule for the commissioning process which is integrated with the construction schedule. Included shall be the required work by all team members (Commissioning Authority, design team, contractors, and the Owner). Overlay with the construction schedule, and include time for testing, verification, and functional performance testing.

3.2 CONSTRUCTION OBSERVATION

A. This is an additional and separate activity from that provided by the design team. Construction observation is required as part of the commissioning and coordination process to be provided by the Commissioning Authority.

3.3 TESTING AND VERIFICATION

A. Testing and Verification shall be accomplished by the Contractor or Their Designee. The Commissioning Authority shall spot check this work to verify accuracy of results.

3.4 VERIFICATION AND FUNCTIONAL PERFORMANCE TEST PROCEDURES

A. The Commissioning Authority shall develop and document the commissioning procedure to be used. Include a performance checklist and performance test data sheets for each system based on actual system configuration. These procedures shall be reviewed by the appropriate design engineers for technical depth, clarity of documentation and completeness. Special emphasis shall be placed on testing procedures that shall conclusively determine actual system performance and compliance with the design intent.

B. The majority of electrical equipment requires safety devices to stop and/or prevent operation unless minimum safety standards or conditions are met. The Commissioning Authority shall observe the actual performance of safety devices in a real or closely simulated condition of failure.

C. Systems may include safety devices and components that control a variety of equipment operating as a system. Interlocks may be hard-wired or operate from software. Operation of these interlocks shall be verified by the Commissioning Authority.

D. The Commissioning Authority shall determine the acceptance procedures for each system. The acceptance procedures shall incorporate the commissioning standards and successful testing results.

E. The appropriate contractor and vendor(s) shall be informed of what tests are to be performed and the expected results. Whereas some test results and interpretations may not become evident until the actual tests are performed, all parties shall have a reasonable understanding of the requirements. The Commissioning Plan shall address those requirements and be distributed to all parties involved with that particular system.

F. Acceptance procedures shall confirm the performance of systems to the extent of' the design intent. When a system is accepted, the Owner shall be assured that the system is complete, works as intended, is correctly documented, and operator training has been performed.

3.5 FUNCTIONAL PERFORMANCE TESTING - OBSERVATION

A. The functional performance testing shall be done by the Contractor. The Commissioning Authority shall direct and witness all of these tests.

B. Tests shall be completed comprehensively and to the extent necessary to enable

the Commissioning Authority to assure the Owner and design professional that the systems do perform per the design intent.

3.6 RE-TESTING

A. The Contractor shall, at no additional cost to the Owner, repeat the entire verification test procedure for each test for which acceptable results are not achieved. Tests shall be repeated until acceptable results are achieved.

B. The Contractor shall compensate the Owner for costs incurred as the result of tests repeated. This includes the costs for the Commissioning Authority, Design Architect, Design Engineers, and Owners personnel.

3.7 CORRECTION OF DEFICIENCIES

A. The Contractor shall correct functional performance test deficiencies and promptly schedule a retest.

B. Corrections during verification or functional performance test are generally prohibited to avoid consuming the time of personnel waiting for the test- but not involved in making the correction. Exceptions will be allowed if the cause of the failure is obvious and corrective action can be completed in less than five minutes. If corrections are made under this exception, the failure shall be noted on the test data form. A new test data form, marked retest, shall be initiated after the correction has been made. The entire test procedure shall be repeated.

3.8 SOFTWARE DOCUMENTATION

A. Review detailed software documentation for all control systems. This includes review of vendor documentation, their programming approach and the specific soft-ware routines applied to this project. Discrepancies in programming approaches and/or sequences shall be reported and coordinated in order to provide the Owner with the most appropriate, simple, and straightforward approach to software routines.

3.9 OPERATING AND MAINTENANCE (O&M) MANUALS

A. The Commissioning Authority shall review the draft form of the O&M manuals provided by the contractor. The review process shall verify that O&M instructions meet specifications and are included for all equipment furnished by the contractor, and that the instructions and wiring diagrams are specific (edited where necessary) to the actual equipment provide for this project.

B. Published literature shall be specifically oriented to the provided equipment indicating required operation and maintenance procedures, parts lists, assembly/disassembly diagrams, and related information.

C. The contractor shall incorporate the standard technical literature into system specific formats for this facility as designed and as actually installed. The resulting O&M information shall be system specific, concise, to the point, and tailored

specifically to this facility. The Commissioning Authority shall review and edit these documents as necessary for final corrections by the contractor.

D. The Commissioning Agent shall:

1. Verify an alphabetical list of all systems components including the name, address and 24 hour phone number of the company responsible for servicing each item during the first years operations is included.
2. Verify the manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed is included in equipment schedules. Physical verification will be used for accuracy.
3. Verify complete operating instructions for entire electrical system.
4. Verify all instructions for emergency procedures, fire or failure of major equipment and procedures for normal starting, operating, shutdown, seasonal and long term shutdown are included.
5. Verify maintenance instructions, proper lubricants and lubricating instructions for each piece of equipment and necessary cleaning/replacing/adjusting schedules are provided.
6. Verify each piece of manufactures data is provided, including:
   a. Installation instructions.
   b. Drawings and specifications (final shop drawings).
   c. Parts lists of each piece of equipment with graphic diagram.
   d. Lubrication and other preventative maintenance data.
7. Verify equipment has been identified as specified on the drawings. Check copy of equipment list in operations and maintenance and compare to equipment identification.
8. Randomly verify all starters disconnect switches and manually operated controls, have been labeled with legible markers corresponding to the operating instructions in the maintenance manual.
9. Verify all extended warranties have been supplied in the maintenance manual in addition to the standard one year warranty. Verify all original copies of warranties for specific equipment where manufactures warranty exceeds the standard one year warranty.
10. Verify the signed Certificate for proof of performance is provided. The signed certificate from the electrical contractor stating they have personally checked the operation of equipment and everything under their said contract is operating as specified.
11. Verify all testing documents for fire system controls or other building electrical tests are supplied and installed in operations and maintenance manual.

3.10 ELECTRICAL IDENTIFICATION

A. Randomly verify all panel boards, starters, disconnect switches, circuit breakers, terminal boards, junction boxes and other special equipment items furnished/or installed by the electrical contractor is identified with permanently attached, engraved plastic name plates.

B. Randomly verify all junction boxes and outlet boxes above ceiling and in unfinished areas and all others shall be permanently and legibly marked as to voltage, phase

characteristics and the panel form wich it is served.

C. Verify each branch circuit in all panel boards have type written identification with complete description of loads served.

D. Randomly verify all empty conduit systems are identified as to the use and junction and outlet boxes and pull wires are identified with point of termination clearly described.

E. Randomly verify each and every wiring system is clearly identified as to the voltage and service, including signal and control conduits.

F. Verify operating instructions include a brochure containing one copy of all approved engineering submitted data, approved diagrams and drawings including all shop drawings required for layout and installation and any and all other data and/or drawings required during construction are also delivered to owner.

G. Verify single line diagram is supplied in main switch gear room, mounted under glass or laminated on the wall.

H. The O&M manual review and coordination efforts shall be completed prior to Owner training sessions, as these documents are to be utilized in the training sessions.

3.11 TRAINING

A. Schedule and coordinate training sessions for the Owner's staff for each system. Training shall be in a classroom setting with the appropriate schematics, handouts, and visual/audio training aids on-site with the vendor’s equipment.

B. The Commissioning Authority organizes, schedules, and directs the training sessions.

C. The appropriate installing contractors shall provide training on all the major systems per specifications, including peculiarities specific to this project.

D. The equipment vendors shall provide training on the specifics of each major equipment item including design philosophy, troubleshooting, and repair techniques.

3.12 RECORD DRAWINGS

A. The Commissioning Authority shall review the as-built contract documents to verify incorporation of both design changes and as-built construction details. Discrepancies noted shall be corrected by the appropriate party. The Commissioning Agent shall:

1. Verify horizontal and vertical location of underground utilities dimensioned off column lines.
2. Verify dimension location of internal utilities in concealed construction.
3. Verify changes by order of field order have been recorded to drawings.

4. Verify all details not on original contract drawings have been converted and recorded on as built drawings.

3.13 EXCLUSIONS

A. Responsibility for construction means and methods: The Commissioning Authority is not responsible for construction means, methods, job safety, or any, construction management functions on the job site.

B. Hands-on work by the Commissioning Authority: The contractors shall provide all services requiring tools or the use of tools to start-up, test, adjust, or otherwise bring equipment and systems into a fully operational state. The Commissioning Authority shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing, and control function.

END OF SECTION 260800

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Indoor occupancy sensors.
3. Lighting contactors.
4. Emergency shunt relays.

B. Related Sections include the following:
1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Provide factory layout drawings showing best placement of devices. Locations shall be coordinated with other ceiling devices and air diffusers.

2. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
   1. TORK #7200.

B. Electromechanical-Dial Time Switches: Type complying with UL 917.

   1. Contact Configuration: DPST.
   2. Contact Rating: 40-A resistive 20 A Inductive, 120-V ac.
   3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
   4. Astronomic time dial.
   5. Skip-a-day mode.

2.2 INDOOR OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
   1. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

   1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
   4. Mounting:

      a. Sensor: Suitable for mounting in any position on a standard outlet box.
      b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.

c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.

D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.3 LIGHTING CONTACTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Square D; Schneider Electric.

4. TORK.
5. Touch-Plate, Inc.
6. Watt Stopper (The).

B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements. Provide a written report of test results and sensor sensitivity/time delay settings.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 260923

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

B. Related Sections include the following:
1. Division 26 Section 262713 “Electricity Metering” for Owner metering requirements.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.

4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail owner's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
10. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Qualification Data: For qualified Installer.

D. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and prevent condensation.

C. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchboards; install electric heating (250-W per section) to prevent condensation.

D. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding 104 deg F.
   b. Altitude: Not exceeding 6600 feet.

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Spare Fuses: Provide 3 spares of each type and rating of fuse and fusible devices used.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.
3. General Electric (GE)
4. Cutler-Hammer

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Nominal System Voltage: [208Y/120 V].

D. Main-Bus Continuous: as shown on drawings.

E. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

F. Indoor Enclosures: Steel, NEMA 250, Type 1.

G. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

H. Barriers: Between adjacent switchboard sections.

I. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

J. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

K. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
3. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
4. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

L. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, with tin-plated copper feeder circuit-breaker line connections.
2. Ground Bus: 1/4-by-2-inch- hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
3. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
4. Neutral Buses: 50 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
5. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

M. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.
4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage.

B. Insulated-Case Circuit Breaker (ICCB): 80 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time time adjustments.
    c. Ground-fault pickup level, time delay, and I^2t response.

C. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Siemens Energy & Automation, Inc.
    b. Square D; a brand of Schneider Electric.
    c. General Electric Company.
    d. Cutler Hammer

2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
    a. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.

2.3 INSTRUMENTATION AND METERING

A. Comply with requirements for owner's metering as specified in Division 26 Section "Electrical Metering".

B. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; with secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

C. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Comply with requirements for owner's metering specified in Division 26 Section ""Electrical Metering."

2.4 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.5 IDENTIFICATION

A. Nameplate: At least 0.0625-inch-thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.

B. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

C. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Comply with requirements for terminating cable trays specified in Division 26 Section "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Instruments and Equipment:

      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Switchboard will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Qualification Data.

D. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
   b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spare for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.
3. General Electric.
4. Cutler-Hammer.

D. Enclosures: Flush- and surface As specified on the drawings -mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Kitchen or Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Finishes:

a. Panels and Trim: Steel factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Same finish as panels and trim.

5. Directory Card: Inside panelboard door, mounted in transparent card holder.

E. Incoming Mains Location: As required.

F. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

H. Service Equipment Label: UL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

I. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

2.2 PANELBOARD SHORT-CIRCUIT RATING

A. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
1. Lighting and appliance branch-circuit panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an UL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an UL.

2.3 DISTRIBUTION PANELBOARDS

A. Panelboards: NEMA PB 1, power and feeder distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

C. Mains: Circuit breaker or Lugs as shown.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: As specified on the drawings.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
   d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   e. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
   f. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
   g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
   h. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
   i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
   j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
   k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
   l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
3. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting: Fasten enclosures firmly to walls and structural surfraces, ensuring tha they are permanently and mechanically anchored.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim 74 inches above finished floor unless otherwise indicated.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

K. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section “Grounding and Bonding for Electrical System”.

B. Connect wiring according to Division 26 Section “Low-voltage Electrical Power Conductors and Cables”.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Provide a written report to certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

E. Panelboards will be considered defective if they do not pass tests and inspections.

3.6 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metering equipment, terminal blocks and data provisions for metering low voltage distribution equipment.

1.3 DEFINITIONS

A. C.T.: Circuit Transformer

B. P.T.: Potential Transformer

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For electricity-metering equipment.

1. Dimensioned plans and sections or elevation layouts.
2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

C. Field quality-control reports.

D. Operation and Maintenance Data. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Equipment installation and user manual documentation.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

1. Meter and appurtenances: Hawk Eye 8100, or equivalent.
2. Shorting Block: General Electric.

B. General Requirements for Electric Meters:

1. Provide Current Transformers, sized for the service entrance ampacity and as recommended by the manufacturer.
   a. Meter Locations: Main distribution panel.
      1) Monitor without Display
2. Complete wall mounted system with communication board and integration to campus BAS.
   a. Insulation Class 600 VAC
   b. Internal Isolation 2500 VAC
   c. Operation Temp. Range 0 to 50 Degrees C
   d. Accuracy +/- 1% of Reading
   e. Power Consumption 50VA
   f. Protection Class NEMA 1
   g. Data Output
      1) kwh – Consumption
      2) KW – Real Power
      3) KVAR – Reactive Power
      4) KVA – Apparent Power
      5) Power Factor
      6) Voltage Line to Line
      7) Voltage Line to Neutral
      8) Amps – Average Current
      9) Use JCI compatible output to connect to building BAS (BACnet compatible)

C. General Requirements for Shorting Block:
   1. Provide a separate six-terminal shorting block for each electrical meter, such that such that connection of all current transformer secondary leads (+ and -) for each phase can be accommodated.
   2. General Electric Catalog #EB27B06S. No equivalent shorting block shall be accepted on this project.
   3. Finger-safe voltage-appropriate fusing (or "open" fuse block with manual switch disconnect) for all potential leads and meter power. Fuse values of ½ ampere or as specified in metering installation manual. (If meter permits, control power can be derived from potential leads, if properly fused.)
   4. Ringed terminals for all C.T. lead connections at instrument transformer and terminal block.

2.2 CONDUCTOR REQUIREMENTS:

A. Current Transformer-secondary leads:

   1. #10 THHN or metering wire.

B. Potential Transformer-120V secondary leads or metering conductors tapped directly from power transformer secondary lugs:

   1. #12 THHN or metering wire.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

3.2 METER CONDUCTOR IDENTIFICATION

A. Potential Transformer Lead Identification

   1. If potential leads are derived from secondary of a separately installed P.T., use the following color codes (or appropriate tagging-such as shown-indicating phase):

a.	A phase	Black	A Ø PT	Va
b.	B phase	Red	B Ø PT	Vb
c.	C phase	Blue	C Ø PT	Vc
d.	Neutral	White	PT (Neut)	Vn
e.	Ground	Green		

   2. When potential leads are tapped from a power transformer secondary lug, use voltage appropriate color codes or tagging-such as shown-indicating phase:

a.	Phases	208Y/ 120 V	Tagging Example	
	A phase	Black	A Ø PT	Va
	B phase	Red	B Ø T	Vb
	C phase	Blue	C Ø T	Vc
	Neutral	White	PT (Neut)	Vn
	Ground	Green		

B. Current Transformer Lead Identification

1. C.T. Metering Leads:
   a. Positive leads shall be #10 THHN, identified as shown below, regardless of service entrance voltage.
      1) A Ø Phase Black
      2) B Ø Phase Red
      3) C Ø Phase Blue
   b. Return (negative) leads can be white #10 but must be tagged with colored tape at the terminations to match associated positive lead. (Positive and negative leads must be distinguishable from each other.)
   c. Current transformer secondaries should be grounded at the shoring block or test switch with a green grounding conductor connected to the return lead(s).
   d. If single-color metering wiring is used, appropriate permanent tagging or identification of each phase of each C.T. and P.T. installed (with an associated line diagram within the metering enclosure) is required.
   e. (i.e.: Ia+, Ia-, Va Ib+, Ib-, Vb Ic+, Ic-, Vc Vn)
   f. Note: Current transformer H1 or dot markings face the source. Secondary X1 markings or dots are positive.
   g. Instrument transformer secondary circuits require grounding.

3.3 MOUNTING AND SUPPORTING

A. Potential transformers and buss-style current transformers must be permanently and securely mounted to a solid structure—which will sufficiently support their weight—within the cabinet or compartment in which they are installed. If instrument transformers are provided with integral secondary termination compartments, they shall be situated for easy access.

B. Donut-style C.T.s—installed directly over conductors or transformer bushings—shall be supported and secured in such a way that they cannot rotate or move (causing strain on leads or contact with a metal surface which could inadvertently shunt secondary circuit).

C. If donut –style C.T.'s are not available, provide 0.6kV class, oval-shaped donut-style C.T.s with integral supporting fins which prevent rotation of C.T. mounted directly on power transformer secondary bushing should need no other means of support.

3.4 METER COMMUNICATIONS

A. For each project with new Powerlogic metering installations, provide one means of Ethernet communications for integration with the new electrical equipment.

B. For each new electric meter installed, provide a one-inch (1") conduit from meter location to the building Communication Main Distribution Frame (MDF) or cable tray, whichever is closer. Label the conduit as "Powerlogic Metering."

C. If metering is installed outdoors, such as on a primary voltage metering cabinet or transformer enclosure, provide a separate conduit to the Owner's nearest communication vault or building Communication Main Distribution Frame (MDF).

3.5 METER PHYSICAL PROTECTION

A. Meters shall be ordered and factory installed with their associated gear (i.e.: primary metering cabinets or panelboards, etc).

B. Where installed in the field by a contractor, the meter shall be neatly and conveniently installed in associated gear or in a separate cabinet where appropriately separated and shielded from high-energy conductors and buss bars, and protected from the elements and other damage.

C. Remote installations require NEMA 12 enclosures with a hinged door.

D. Outdoor installations require consideration that adequately maintains above-freezing temperatures in meter enclosure and prevents the accumulation of condensation. For outdoor locations, provide the following:
   1. 250 watt, 120v heater with a thermostat.
   2. NEMA 12 enclosure with provision for a pad lock. Mount top of enclosure at 72” above final grade.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

   1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
   2. Turn off circuits supplied by metered feeder and secure them in off condition.
   3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
   4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262713

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge suppression units.
4. Snap switches and wall-box dimmers.
5. Wall-switch.
6. Pendant cord-connector devices.
7. Cord and plug sets.
8. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Provide a sample of each type of device to be used.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; GF20.
   b. Pass & Seymour; 2084.

2.4 TVSS RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.

1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex TVSS Convenience Receptacles:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; 5362BLS.
   b. Hubbell; HBL5362SA.
   c. Leviton; 5380.

3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; L520R.
   b. Hubbell; HBL2310.
   c. Leviton; 2310.
   d. Pass & Seymour; L520-R.

3. Verify voltage and Amperage.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.7 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221PL for 120 V and 277 V.
b. Hubbell; HPL1221PL for 120 V and 277 V.
c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.

d. Pass & Seymour; PS20AC1-PLR for 120 V.

3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

2.9 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch-thick.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates:
1. NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.
2. NEMA 3R-in-Use cover, plastic, weather resistant.

2.10 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

2.11 MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with standard finish.

D. Wire: No. 12 AWG.

2.12 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: white, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use engraved machine printing with black-filled lettering on face, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600-V ac and less for use in enclosed switches, and enclosed controllers.
2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches and fuseholders.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

B. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
1. Let-through current curves for fuses with current-limiting characteristics.
2. Time-current curves, coordination charts and tables, and related data.
3. Fuse size for elevator feeders and elevator disconnect switches.

C. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

D. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

a. Let-through current curves for fuses with current-limiting characteristics.
b. Time-current curves, coordination charts and tables, and related data.
c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA FU 1.

D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Quantity equal to 5 percent of each fuse type and size, but no fewer than 2 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. NEMA FU 1 class is same as UL class. Class defines fuse performance category, including interrupting rating. See Editing Instruction No. 2 in the Evaluations.

B. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

E. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

3.2 FUSE APPLICATIONS

1. Motor Branch Circuits: Class RK1, time delay.
2. Control Circuits: Class CC, fast acting.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.

3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.
3. General Electric Company.
4. Cuttler-Hammer.

B. Provide fusible switches with quantity of poles and amperage, as indicated on the drawings.

C. Type HD, Heavy Duty, Single Throw, [240] [600]-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.

B. Provide fusible switches with quantity of poles and amperage, as indicated on the drawings.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 SHUNT TRIP SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Green ON pilot light.
3. 100 percent rating.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Fire-safety and alarm relay; 120-V ac coil voltage.
7. Fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.
3. General Electric Company.
4. Cuttler-Hammer

B. Show pole quantities and voltage and ampere ratings of MCCBs and switches on Drawings.

C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

D. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

E. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

F. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

G. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
6. Alarm Switch: One NO/NC contact that operates only when circuit breaker has tripped.

2.5 MOLDED-CASE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.
3. General Electric Company.
4. Cuttler-Hammer

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
6. One NO/NC contact that operates only when switch has tripped.
7. Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.

8. Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
9. Provide remote control for on, off, and reset operations.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R
3. NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

END OF SECTION 262816

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.

B. Related Sections include the following:

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For manufacturer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Source Limitations: Obtain [automatic transfer switches] through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA ICS 1.

E. Comply with NFPA 70.

F. Comply with NFPA 99.

G. Comply with NFPA 110.

H. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Contactor Transfer Switches:
      a. Kohler Power Systems; Generator Division. To match the existing genset and controls.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

   1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
   2. Switch Action: Double throw; mechanically held in both directions.
   3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."

   1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
   2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
   3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

H. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

D. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.

E. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Elevator override provision.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for

compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Identify components according to Division 26 Section "Identification for Electrical Systems."

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.

d. Verify pickup and dropout voltages by data readout or inspection of control settings.

e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264313 - SURGE PROTECTIVE DEVICES (SPDs) LOW VOLTAGE AC SURGE PROTECTION FOR ELECTRICAL DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in:

1.02 RELATED SECTIONS

A. Section 26 24 16 – Panelboards

1.03 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
2. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

B. Where applicable the following additional information shall be submitted to the engineer:

1. Descriptive bulletins
2. Product sheets

1.05 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process

1.06 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.07 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.08 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Cutler-Hammer

B. Current Technology, Inc.

C. United Power, Inc.

D. Intermatchi.

E. LEA International.

F. EFI Electronics.

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 125% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye				
Delta	N/A			N/A
Single Split Phase				
High Leg Delta				

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
      i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also

contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

d. ∃Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

6. Overcurrent Protection

a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

8. Safety Requirements

a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections

shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.03 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.04 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
3. The panelboard shall be capable of re-energizing upon removal of the SPD.
4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed

using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.

5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
6. The SPD shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the SPD shall be UL67 listed.

B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)

1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

C. Switchgear, Switchboard, MCC and Busway Requirements

1. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway
3. The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.05 ENCLOSURES

A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water);

and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only)

3. NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only)

PART 3 EXECUTION

3.01 EXAMINATION

3.02 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.03 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.04 WARRANTY

A. The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

END OF SECTION 264313

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

B. Related Sections include the following:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast.
4. Energy-efficiency data.
5. Life, output, and energy-efficiency data for lamps.
6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
    b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power and control wiring.

C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Lighting fixtures.
2. Suspended ceiling components.
3. Structural members to which suspension systems for lighting fixtures will be attached.
4. Other items in finished ceiling including the following:

    a. Air outlets and inlets.
    b. Speakers.
    c. Sprinklers.
    d. Smoke and fire detectors.
    e. Occupancy sensors.
    f. Access panels.

5. Perimeter moldings.

D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:

1. Lamps: Specified units installed.
2. Accessories: Cords and plugs.

E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

F. Qualification Data: For agencies providing photometric data for lighting fixtures.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.

B. Special Warranty for T5 and T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: One year from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Furnish stock or replacement lamps amounting to 2%, but not less than 2 lamps in each case, of each type and size lamp used in each type fixture (indoor and outdoor). Deliver replacement stock as directed to the Owner's storage space.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified on the fixture schedule in the drawings.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.

G. Plastic Diffusers, Covers, and Globes:

   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

      a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
      b. UV stabilized.

   2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; Program-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.

1. Sound Rating: A.
2. Total Harmonic Distortion Rating: Less than 10 percent.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Operating Frequency: [20] kHz or higher.
5. Lamp Current Crest Factor: 1.7 or less.
6. BF: 0.78.
7. Power Factor: [0.95] or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

C. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F and Higher: [Electronic] type rated for 0 deg F starting and operating temperature with indicated lamp types.

D. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.

   a. High-Level Operation: 100 percent of rated lamp lumens.
   b. Low-Level Operation: 50 percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Ballast Case Temperature: 75 deg C, maximum.

2.5 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

   2. Master/Remote Sign Configurations:

      a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply for power connection to remote unit.
      b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.6 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

B. T8 premium program-start low-mercury lamps, rated 28 W maximum, nominal length of 48 inches, 2725 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours, unless otherwise indicated.

C. T8 premium program-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.

D. T5 program-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.

E. T5HO program-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.

F. Compact Fluorescent Lamps: program-start 4-Pin, low mercury, CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

   1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
   2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
   3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
   4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
   5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
   6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

2.8 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

(See Drawings)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.

E. Adjust aimable lighting fixtures to provide required light intensities.

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Exterior luminaires with lamps and ballasts.
2. Poles and accessories.

B. Related Sections include the following:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CRI: Color-rendering index.

B. HID: High-intensity discharge.

C. Luminaire: Complete lighting fixture, including ballast housing if provided.

D. Pole: Luminaire support structure, including tower used for large area illumination.

E. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.

B. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.

1. Wind speed for calculating wind load for poles exceeding 50 feet in height is 110 mph.
2. Wind speed for calculating wind load for poles 50 feet or less in height is 110 mph.

1.5 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
   a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
6. Ballasts, including energy-efficiency data.
7. Lamps, including life, output, and energy-efficiency data.
8. Materials, dimensions, and finishes of poles.
9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
10. Anchor bolts for poles.

B. Shop Drawings:

1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
2. Wiring Diagrams: Power and control wiring.

C. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.

D. Qualification Data: For agencies providing photometric data for lighting fixtures.

E. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps. Store poles in a dry area. Pole wrappings shall not be permitted to get wet.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: One year from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

1.9 EXTRA MATERIALS See specification section 265100

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Exterior Lighting Device Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field. Provide shields as shown of the drawings.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
   a. Color: Owners standard color is Deseret Bronze.

2.3 FLUORESCENT BALLASTS AND LAMPS

A. Low-Temperature Ballast Capability: Rated by its manufacturer for reliable starting and operation of indicated lamp(s) at temperatures 0 deg F and higher.

B. Ballast Characteristics:

1. Power Factor: 90 percent, minimum.
2. Sound Rating: A.
3. Total Harmonic Distortion Rating: Less than 10 percent.
4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
6. Transient-Voltage Protection: Comply with IEEE C62.41 Category A or better.

C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures 0 deg F and higher.

D. Fluorescent Lamps: Low-mercury type. Comply with the EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

E. Ballast Fuses: One for each ballast. Voltage and current ratings as recommended by ballast manufacturer.

2.4 BALLASTS FOR HID LAMPS

A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features, unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F.
3. Normal Ambient Operating Temperature: 104 deg F.
4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

2.5 HID LAMPS

A. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

B. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

2.6 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
3. Anchor-Bolt Template: Plywood.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

2.7 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.

B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Shape: Round, straight.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
2. Finish: Same as pole and luminaire.

F. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
   a. Color: Owners standard color is Deseret Bronze.

2.8 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

3.2 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole, or as shown on the drawings.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches.
2. Water, Gas, Electric, Communication, and Sewer Lines: 3 feet.
3. Trees: 10 feet.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.7 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

END OF SECTION 265600

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetallic wireways and auxiliary gutters.
5. Surface pathways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Division 26 Section "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental

Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. General Requirements for Metal Conduits and Fittings:
1. Refer to section 260533 "RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS"

2.2 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-B.
2. Refer to section 260533 "RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS"

2.3 CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

A. General Requirements for Boxes, Enclosures, and Cabinets:
1. Refer to section 260536 "CABLE TRAYS FOR ELECTRICAL SYSTEMS"

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Damp or Wet Locations: GRC.
5. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
6. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
7. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.
8. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 1-inch trade size. Minimum size for optical-fiber cables is 1 inch.

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

M. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

O. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

P. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

Q. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

R. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

S. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

T. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
   e. Insert location and corresponding temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

U. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

V. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

W. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

Z. Set metal floor boxes level and flush with finished floor surface.

AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply

with requirements in Division 27 Section "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

SECTION 283111-DIGITAL, ADDRESSABLE FIRE ALARM SYTEM

PART 1 GENERAL

1.1. DESCRIPTION:

A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.

B. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

C. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).

D. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

1.2. SCOPE:

A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.

B. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 7 (Class A) Signaling Line Circuits (SLC).

2. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.

3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.

4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
6. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone which ever is greater.
7. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.
8. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.
9. Two-way telephone communication circuits shall be supervised for open and short circuit conditions.

C. BASIC SYSTEM FUNCTIONAL OPERATION

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The system alarm LED on the system display shall flash.
2. A local piezo electric signal in the control panel shall sound.
3. A backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
4. Printing and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

1.3. SUBMITTALS

A. General:

1. Two copies of all submittals shall be submitted to the Architect/Engineer for review.
2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
3. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show annunciator layout, configurations, and terminations.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

D. Software Modifications

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site.

E. Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.4. GUARANTY:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.5. POST CONTRACT MAINTENANCE:

A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.

B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

C. Maintenance and testing shall be on a semiannual basis or as required by the AHJ. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:

1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, waterflow switches and all accessories of the fire alarm system.
2. Each circuit in the fire alarm system shall be tested semiannually.
3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 7.

1.6. POST CONTRACT EXPANSIONS:

A. The contractor shall have the ability to provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.

B. As part of the submittal, include a quotation for all parts and material, and all installation and test labor as needed to increase the number of intelligent or addressable devices by ten percent (10%). This quotation shall include intelligent smoke detectors, intelligent heat detectors, addressable manual stations, addressable monitor modules and addressable modules equal in number to one tenth of the number required to meet this specification (list actual quantity of each type).

C. The quotation shall include installation, test labor, and labor to reprogram the system for this 10% expansion. If additional FACP hardware is required, include the material and labor necessary to install this hardware.

D. Do not include cost of conduit or wire or the cost to install conduit or wire except for labor to make final connections at the FACP and at each intelligent addressable device. Do not include the cost of conventional peripherals or the cost of initiating devices or notification appliances connected to the addressable monitor/control modules.

E. Submittals that do not include this estimate of post contract expansion cost will not be accepted.

1.7. APPLICABLE STANDARDS AND SPECIFICATIONS:

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

A. National Fire Protection Association (NFPA) - USA:

No. 12 CO2 Extinguishing Systems (low and high)
No. 12B Halon 1211 Extinguishing Systems
No. 13 Sprinkler Systems
No. 13A Halon 1301 Extinguishing Systems
No. 15 Water Spray Systems
No. 16 Foam/Water Deluge and Spray Systems
No. 17 Dry Chemical Extinguishing Systems
No. 17A Wet Chemical Extinguishing Systems
No. 2001 Clean Agent Extinguishing Systems
No. 72 National Fire Alarm Code
No. 101 Life Safety Code

B. Underwriters Laboratories Inc. (UL) - USA:

No. 268 Smoke Detectors for Fire Protective Signaling Systems
No. 864 Control Units for Fire Protective Signaling Systems
No. 268A Smoke Detectors for Duct Applications
No. 521 Heat Detectors for Fire Protective Signaling Systems
No. 464 Audible Signaling Appliances
No. 38 Manually Actuated Signaling Boxes
No. 346 Waterflow Indicators for Fire Protective Signaling Systems
No. 1076 Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971 Visual Notification Appliances
No. 217 217 Smoke Detectors, Single and Multiple Station
N0. 228 Door Closers - Holders for Fire Protective Signaling System.
No. 1481 Power Supplies for Fire Protective Signaling Systems
No. 60951 Safety of Information Technology Equipment

1.8. APPROVALS:

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:
UL Underwriters Laboratories Inc

B. The fire alarm control panel shall meet UL Standard 864 Ninth Edition (Control Units) and UL Standard 1076 (Proprietary Burglar Alarm Systems).

PART 2.0 PRODUCTS

2.1. EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2. CONDUIT AND WIRE:

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760.
4. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 3/4-inch (19.1 mm) minimum.

B. Wire:

1. All fire alarm system wiring shall be new.
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits, Signaling Line Circuits, and Notification Appliance Circuits.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 12,500 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.
6. All field wiring shall be electrically supervised for open circuit and ground fault.
7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.

C. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent

reporting devices.

E. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

2.3. MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

A. Main FACP or network node shall be a NOTIFIER Model NFS2-640 and shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.

B. Operator Control

1. Acknowledge Switch:

a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.
b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Alarm Silence Switch:
Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.
3. Alarm Activate (Drill) Switch:
The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.
4. System Reset Switch:
Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.
5. Lamp Test:
The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal

C. System Capacity and General Operation

1. The control panel or each network node shall provide, or be capable of expansion to 636 intelligent/addressable devices.
2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC.
3. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notification Appliance Circuits
4. The Notification Appliance Circuits shall be programmable to Synchronize with System Sensor, Gentex and Wheelock Notification Appliances.
5. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system sta-

tus LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.

6. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
7. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.
   The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of a PC with a software utility designed for programming.
8. The FACP or each network node shall provide the following features:

   a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
   b. Detector sensitivity test, meeting requirements of NFPA 72.
   c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
   d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advanced detection laser detectors with an alarm level range of .02 percent per foot to 2.0 percent per foot. The system shall also include up to nine levels of Prealarm, selected by detector, to indicate impending alarms to maintenance personnel.
   e. The ability to display or print system reports.
   f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
   g. PAS presignal, meeting NFPA 72 requirements.
   h. Rapid manual station reporting (under 3 seconds) and shall meet NFPA 72 requirements for activation of notification circuits within 10 seconds of initiating device activation.
   i. Periodic detector test, conducted automatically by the software.
   j. Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its prealarm level to just above normal peaks.
   k. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
   l. Walk test, with a check for two detectors set to same address.
   m. Control-by-time for non-fire operations, with holiday schedules.
   n. Day/night automatic adjustment of detector sensitivity.
   o. Device blink control for sleeping areas.

9. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), Temporal (NFPA 72), and California Code. Panel notification circuits (NAC 1, 2, 3 and 4) shall also support Two-Stage operation, Canadian Dual Stage (3 minutes) and Canadian Dual Stage (5 minutes). Two stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. Canadian Dual stage is the same as Two-Stage except will only switch to second stage by activation of Drill Switch 3 or 5 minute timer. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."
10. Network Communication

    a. The FACP shall be capable of communicating on a Local Area Network (LAN), a firmware package that utilizes a peer-to-peer, inherently regenerative communication format and protocol.

D. Central Microprocessor

1. The microprocessor shall be a state-of-the-art, high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, Flash memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
4. A special program check function shall be provided to detect common operator errors.
5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.
6. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in incompliance with the NFPA 72 requirements for testing after system modification.

E. System Display

1. The system shall support the following display mode options:

   a. 80 character display option. The display shall include an 80-character backlit alphanumeric Liquid Crystal Display (LCD) and a full PC style QWERTY keypad.

2. The display shall provide all the controls and indicators used by the system operator:

   a. The 80-character display shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST.

3. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
4. The display shall also provide Light-Emitting Diodes.

   a. The 80-character display shall provide 12 Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, ALARM SILENCED, Controls Active, Pre-Discharge, Discharge and Abort.

5. The display shall have QWERTY type keypad.

   a. The 80-character display keypad shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.

6. The system shall support the display of battery charging current and voltage on the 80-character LCD display.

F. Signaling Line Circuits (SLC)

1. Each FACP or FACP network node shall support up to two SLCs. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photo-electric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices. The addition of the optional second loop shall double the device capacity, supporting a total of 636 devices. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
2. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, prealarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

G. Serial Interfaces

1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.

   a. The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

F. Digital Voice Command Center

1. The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset. The DVC shall support up to 8 channels of voice when configured with Digital Audio Amplifiers and 4 channels of voice when employing the optional analog output card. Each DVC shall support up to 32 digital audio amplifiers.
2. Function: The Voice Command Center equipment shall perform the following functions:
   a. Operate as a supervised multi-channel emergency voice communication system.
   b. Operate as a two-way emergency telephone system control center.
   c. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
   d. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
   e. Provide all-call Emergency Paging activities through activation of a single control switch.
   f. As required, provide vectored paging control to specific audio zones via dedicated control switches.
   g. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.
   h. Provide a software utility capable of off-line programming for the VCC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the VCC shall not inhibit the emergency operation of other nodes on the fire alarm network.
   i. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SCL controlled switching.

j. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.

k. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.

3. The emergency voice alarm communication system shall incorporate a Two-way emergency telephone communication system.

a. Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.

b. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Digital Voice Command Center and up to seven (7) remote Fire Fighter's Telephone locations simultaneously on a telephone riser.

c. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.

G. Audio Amplifiers

1. The Audio Amplifiers will provide Audio Power (@25 Volt RMS or 70 RMS) for distribution to speaker circuits.

2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).

3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:

- Earth Fault on DAP A (Digital Audio Port A)
- Earth Fault on DAP B (Digital Audio Port B)
- Audio Amplifier Failure Detected Trouble
- Active Alarm Bus input
- Audio Detected on Aux Input A
- Audio Detected on Aux Input B
- Audio Detected on Firefighter's Telephone Riser
- Receiving Audio from digital audio riser
- Short circuit on speaker circuit 1
- Short circuit on speaker circuit 2
- Short circuit on speaker circuit 3
- Short circuit on speaker circuit 4
- Data Transmitted on DAP A
- Data Received on DAP A
- Data Transmitted on DAP B
- Data Received on DAP B
- Board failure
- Active fiber optic media connection on port A (fiber optic media applications)
- Active fiber optic media connection on port B (fiber optic media applications)
- Power supply Earth Fault
- Power supply 5V present
- Power supply conditions - Brownout, High Battery, Low Battery, Charger Trouble

4. The audio amplifier shall provide the following built-in controls:

- Amplifier Address Selection Switches
- Signal Silence of communication loss annunciation Reset
- Level adjustment for background music
- Enable/Disable for Earth Fault detection on DAP A
- Enable/Disable for Earth Fault detection on DAP A

- Switch for 2-wire/4-wire FFT riser

5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
7. System shall be capable of backing up digital amplifiers.
8. One-tone backup shall be provided by either a plug-in-amplifier card or a designated back-up amplifier of identical model as the primary amplifier.
9. One designated backup amplifier shall be capable of backing up multiple primary amplifiers mounted in the same or adjacent cabinets.
10. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.

H. Audio Message Generator (Prerecorded Voice)/Speaker Control:

1. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.
2. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.
3. A built-in microphone shall be provided to allow paging through speaker circuits.
4. System paging from emergency telephone circuits shall be supported.
5. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:

   LED Indicators:
   - Lamp Test
   - Trouble
   - Off-Line Trouble
   - Microphone Trouble
   - Phone Trouble
   - Busy/Wait
   - Page Inhibited
   - Pre/Post Announcement Tone

I. Controls with associated LED Indicators:

1. Speaker Switches/Indicators

   a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
   b. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.

2. Emergency Two-Way Telephone Control Switches/Indicators

   a. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
   b. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

J. Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush

mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.

2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.

K. Power Supply:

1. A high tech off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices.
2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 55 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
4. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:

Ground Fault LED
AC Power Fail LED
NAC on LED (4)

5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
6. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 200 AH.
7. All circuits shall be power-limited, per UL864 requirements.

L. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
4. Point Read: The system shall be able to display or print the following point status diagnostic functions:

   a. Device status
   b. Device type
   c. Custom device label
   d. View analog detector values
   e. Device zone assignments
   f. All program parameters

5. System Status Reports: Upon command from an operator of the system, a status report will

be generated and printed, listing all system status.

6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
9. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.
10. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:

    a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
    b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
    c. All devices tested in walk test shall be recorded in the history buffer.

11. Waterflow Operation
    An alarm from a waterflow detection device shall activate the appropriate alarm message on the main panel display, turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.
12. Supervisory Operation
    An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.
13. Signal Silence Operation
    The FACP shall have the ability to program each output circuit (notification, relay, speaker etc) to deactivate upon depression of the signal silence switch.
14. Non-Alarm Input Operation
    Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.
15. Combo Zone
    A special type code shall be available to allow waterflow and supervisory devices to share a common addressable module. Waterflow devices shall be wired in parallel, supervisory devices in series.

2.4. SYSTEM COMPONENTS:

A. Audible/Visual Combination Devices:

1. Shall meet the applicable requirements of Section A listed above for audibility.
2. Shall meet the requirements of Section B listed above for visibility.

B. Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:

1. The maximum pulse duration shall be 2/10 of one second
2. Strobe intensity shall meet the requirements of UL 1971.
3. The flash rate shall meet the requirements of UL 1971.

C. Alphanumeric LCD Type Annunciator:

1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
2. The LCD annunciator shall display all alarm and trouble conditions in the system.
3. An audible indication of alarm shall be integral to the alphanumeric display.
4. The display shall be UL listed for fire alarm application.
5. It shall be possible to connect up to 32 LCD displays and be capable of wiring distances up to 6,000 feet from the control panel.
6. The annunciator shall connect to a separate, dedicated "terminal mode" EIA-485 interface. This is a two-wire loop connection and shall be capable of distances to 6,000 feet. Each terminal mode LCD display shall mimic the main control panel.
7. The system shall allow a minimum of 32 terminal mode LCD annunciators. Up to 10 LCD annunciators shall be capable of the following system functions: Acknowledge, Signal Silence and Reset, which shall be protected from unauthorized use by a key switch or password.
8. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

D. Field Wiring Terminal Blocks

For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

2.5. SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices - General

1. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
2. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.

5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Bases shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.
8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
12. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
13. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

B. Addressable Manual Fire Alarm Box (manual station)

1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

C. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

D. Intelligent Duct Smoke Detector

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

E. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with a current rating of 2 Amps for Style Z and 3 Amps for Style Y. For speaker applications the module is rated for 50 watts at 25 or 70.7 Vrms.
3. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.

F. Addressable Relay Module

1. Addressable Relay Modules shall be available for HVAC control and other building functions. The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary devices energize at the same time on the same pair of wires.
2. For multiple relay control a module shall be available that provides 6 programmable Form-C relays.

2.6. BATTERIES:

A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

C. If necessary to meet standby requirements, external battery and charger systems may be used.

PART 3.0 - EXECUTION

3.1. INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2. TEST:

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72,

Chapter 7.

A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

C. Verify activation of all waterflow switches.

D. Open initiating device circuits and verify that the trouble signal actuates.

E. Open and short signaling line circuits and verify that the trouble signal actuates.

F. Open and short notification appliance circuits and verify that trouble signal actuates.

G. Ground all circuits and verify response of trouble signals.

H. Check presence and audibility of tone at all alarm notification devices.

I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3. FINAL INSPECTION:

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4. INSTRUCTION:

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION 283111

SECTION 310700 - GENERAL SITE CONSTRUCTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited to
1. General procedures and requirements for Site Work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PREPARATION

A. Site Verification Of Conditions
1. 48 hours minimum prior to performing any work on site, contact Dig Line to arrange for utility location services.
2. Perform minor, investigative excavations to verify location of various existing underground facilities at sufficient locations to assure that no conflict with the proposed work exists and sufficient clearance is available to avoid damage to existing facilities.
3. Perform investigative excavating 5 days minimum in advance of performing any excavation or underground work.
4. Upon discovery of conflicts or problems with existing facilities, notify Architect by phone or fax within 24 hours. Follow telephone or fax notification with letter and diagrams indicating conflict or problem and sufficient measurements and details to evaluate problem.
5. Notify Owner of utilities a minimum of 48 hours prior to an work taking place.

3.2 PREPARATION

A. Protection
1. Spillage -
   a. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways.
   b. Remove spillage and sweep, wash, or otherwise clean project, streets, and highways.
2. Dust Control -
   a. Take precautions necessary to prevent dust nuisance, both on-site and adjacent to public and private properties.
   b. Correct or repair damage caused by dust.
3. Erosion Control -
   a. Take precautions necessary to prevent erosion and transportation of soil downstream, to adjacent properties, and into on-site or off-site drainage systems.
   b. Develop, install, and maintain an erosion control plan if required by law.
   c. Repair and correct damage caused by erosion.
4. Existing Plants And Features - Do not damage tops, trunks, and roots of existing trees and shrubs on site which are intended to remain. Do not use heavy equipment within branch spread. Interfering branches may be removed only with permission of Architect.

Do not damage other plants and features which are to remain.

5. Protect site from fire caused by welding, cutting, smoking, or other sources of ignition.

B. If specified precautions are not taken or corrections and repairs made promptly, Owner may take such steps as may be deemed necessary and deduct costs of such from monies due to Contractor. Such action or lack of action on Owner's part does not relieve Contractor from responsibility for proper protection of the Work.

3.3 REPAIR / RESTORATION

A. Adjust existing covers, boxes, and vaults to grade.

B. Replace broken or damaged covers, boxes, and vaults.

C. Independently confirm size, location, and number of covers, boxes, and vaults which require adjustment.

3.4 FIELD QUALITY CONTROL

A. Notify Architect 48 hours prior to performing excavation or fill work.

B. If work has been interrupted by weather, scheduling, or other reason, notify Architect 24 hours minimum prior to intended resumption of grading or compacting.

C. Owner reserves right to require additional testing to re-affirm suitability of completed work including compacted soils which have been exposed to adverse weather conditions.

3.5 UTILITY LOCATION REQUIREMENTS

A. The Contractor shall at his cost provide GPS coordinates for all utilites found during demolition, marked or not marked, all utility connection, and all new utility lines. Coordinates will contain a Northing, Easting, Elevation, and Description. Coordinates will be recorded at the following minimum locations:

B. Storm Drain Lines
   1. Manholes, Top and Flowline
   2. Catch Basins, Top and Flowline
   3. Inlet Boxes, Top and Flowline
   4. Cleanouts, Top and Flowling

C Water Lines
   1. Angle Points, Top of Pipe
   2. Valves, Top Nut of Valve & Center Top of Valve Box
   3. Tees, Mid Point Top of Pipe
   4. Elbows, Mid Point Top of Pipe
   5. Connection Points, Top of Pipe

D. Gas Lines
   1. Angle Points, Top of Pipe
   2. Tees, Mid Point, Top of Pipe
   3. Elbows, Mid Point Top of Pipe
   4. Valves, Top Nut of Valve & Cente Top of Valve Box
   5. Connection Points, Top of Pipe

E. Sanitary Sewer
   1. Manholes, Top and Flowline
   2. Tees, Mid Point Top of Pipe

3. Wye, Mid Point Top of Pipe
4. Cleanouts, Top and Flowling
5. Connection Points, Top of Pipe

F. Electrical Lines
1. Angle Points, Top of Line
2. Elbows, Mid Point Top of Conduit
3. Connection Points, Top of Conduit or Top of Line

G. Telephone and Data Lines
1. Angle Points, Top of Line
2. Elbows, Mid Point Top of Conduit
3. Connection Points, Top of Conduit or Top of Line

H. Record Drawing Information
1. All Coordinates are to be inserted into a electronic record drawing set of plans and provided to the civil engineer and to the owner.
2. A paper copy of all coordinates will be provided to the owner and civil engineer on a weekly basis.
3. Failure to record these data points will result in the contractor excavating, locating, providing the coordinates, backfilling, compacting the trenches at no additional expense to the owner.

END OF SECTION - 310700

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SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Protecting existing trees, shrubs, groundcovers, plants, and grass to remain.
2. Removing existing trees, shrubs, groundcovers, plants, and grass as indicated on demolition plan.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, abandoning site utilities in place, and removing site utilities.
7. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:

1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security, protection facilities, and temporary erosion and sedimentation control procedures.
2. Division 01 Section "Temporary Tree and Plant Protection" for protecting trees remaining on-site that are affected by site operations.
3. Division 01 Section "Execution" for verifying utility locations and for recording field measurements.
4. Division 02 Section "Site Demolition" for demolition and site improvements.
5. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
6. Division 32 Section "Turf, Grasses, and Plants" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, sediment and erosion control Drawings, a sediment and erosion control plan, specific to the site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
3. Coat cut faces of roots more than 1-1/2 inches in diameter with emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
4. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Architect.

3.4 UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

E. Removal of underground utilities is included in Division 21, Division 22, Division 26, Division 27, and Division 28 Sections covering site utilities.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within tree protection zone.
5. Remove tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within tree protection zones.
3. Dispose of excess topsoil as specified for waste material disposal.
4. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction. Refer to project plans for improvements to be abandoned in place.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.8 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION - 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Preparing sub-grades for slabs on grade, walks, pavements, lawns and grasses, and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling for utility trenches.
8. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:

1. Geotechnical Report. Requirements in the Geotechnical Report are incorporated by reference. Refer to the Geotechnical Report for requirements.
2. Division 01 Section Construction Progress Documentation and Photographic Documentation for recording pre-excavation and earthwork progress.
3. Division 01 Section “Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
4. Division 01 Section "Temporary Tree and Plant Protection" for protecting and trimming trees to remain.
5. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
6. Divisions 21, 22, 23, 26, 27, and 28 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
7. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above-grade and below-grade improvements and utilities.
8. Division 32 Section "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for lawns.
9. Division 32 Section "Plants" for planting bed establishment and tree and shrub pit excavation and planting.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices and changes in the work.
2. Bulk Excavation: Excavation more than 10-feet in width and more than 30-feet in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, un-stratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cubic yard for bulk excavation or 3/4 cubic yard for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090-lbf and stick-crowd force of not less than 18,650-lbf; measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 48,510-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.
2. Geotextile.
3. Controlled low-strength material, including design mixture.

B. Samples: 12-by-12-inch Sample of sub-drainage and other geotextiles used.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D698 or ASTM D1557 for each on-site and borrow soil material proposed for fill and backfill.

D. Blasting Plan: For record purposes and for approval of authorities having jurisdiction.

E. Seismic Survey Report: For record purposes; from seismic survey agency.

F. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.5 QUALITY ASSURANCE

A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:

1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:

1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

C. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

D. Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM or AASHTO M 145 Soil Classification Groups A-1, A-2-4, A-2-5, and A-3, or a combination of these groups, well graded; free of rock or gravel larger than 3-inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Native rock crushed to meet the above requirements and free from significant porosity may also be used as satisfactory soils.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 3/4-inch sieve and not more than 11 percent passing a No. 200 sieve and meeting the following gradation limits:

1. Gradation Table Base Course:

1”	100%
½”	79-91%
#4	49-61%
#16	27-35%
#200	7-11%

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 88 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve and meeting the following gradation limits.

1. Gradation Table Engineered Fill :

2”	100%
1.5”	88-96%
¾”	80-88%

½”	68-84%
#4	60-78%
#16	35-54%
#200	4-8%

F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 3/4-inch sieve and not more than 8 percent passing a No. 200 sieve and meeting the following gradation limits.

1. Gradation Table Bedding Course:

¾”	100%
3/8”	78-92%
#4	55-67%
#16	28-38%
#200	4-8%

G. Drainage Course: Narrowly graded mixture of washed or crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

H. Subbase Material: Use Engineered Fill.

I. Structural Fill: Use Engineered Fill.

J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

K. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

L. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Non-woven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.

3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:

1. Portland Cement: ASTM C 150, Type II.
2. Fly Ash: ASTM C 618, Class C or F.
3. Normal-Weight Aggregate: ASTM C 33, 3/4-inch to 3/8-inch nominal maximum aggregate size.
4. Foaming Agent: ASTM C 869.
5. Water: ASTM C 94/C 94M.
6. Air-Entraining Admixture: ASTM C 260.

B. Produce low-density, controlled low-strength material with the following physical properties:

1. As-Cast Unit Weight: 30 to 36 lb/cu. ft. at point of placement, when tested according to ASTM C 138/C 138M.
2. Compressive Strength: 80 psi , when tested according to ASTM C 495.

2.4 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows when required by utility purveyor:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Obtain written permission from authorities having jurisdiction and from architect and owner before bringing explosives to Project site or using explosives on Project site.

1. Perform blasting without damaging adjacent structures, property, or site improvements.
2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

   a. 24 inches outside of concrete forms other than at footings.
   b. 12 inches outside of concrete forms at footings.
   c. 6 inches outside of minimum required dimensions of concrete cast against grade.
   d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   e. 6 inches beneath bottom of concrete slabs on grade.
   f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons or vehicle with similar unit axel weight.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices and changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."

D. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 12 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

E. Place and compact initial backfill of subbase material or satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit.

G. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

H. Place and compact final backfill of satisfactory soil to final subgrade elevation.

I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

J. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 12-inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Reduce loose depths as needed to achieve required compactions.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698 or ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent if in landscaping areas or 95 percent if under structures, pavements, or walks.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch
3. Pavements: Plus or minus 1/2 inch

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor].
2. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

3.18 SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends where called for on details and on plans.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase and base course to required crown elevations and cross-slope grades.

4. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
5. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698 or ASTM D 1557.

C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698 or ASTM D 1557 where called for on project plans.

3.19 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.

3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

B. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION - 312000

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes construction dewatering.

B. Related Sections:

1. Division 01 Section "Construction Progress Documentation and Photographic Documentation" for recording preexisting conditions and dewatering system progress.
2. Division 31 Section "Earth Moving" for excavating, backfilling, site grading, and for site utilities.
3. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
4. Division 33 Section "Subdrainage" for permanent foundation wall, underfloor, and footing drainage.

1.3 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

1.4 SUBMITTALS

A. Shop Drawings: For dewatering system. Show typical arrangement, anticipated locations, and typical details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.

1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.

B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Qualification Data: For qualified Installer.

D. Field quality-control reports.

E. Other Informational Submittals:

1. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in dewatering systems and dewatering work.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to dewatering including, but not limited to, the following:

a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
b. Geotechnical report.
c. Proposed site clearing and excavations.
d. Existing utilities and subsurface conditions.
e. Coordination for interruption, shutoff, capping, and continuation of utility services.
f. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
g. Testing and monitoring of dewatering system.
h. Other agenda items.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of utility.

2. Do not proceed with interruption of utility without Architect's, Construction Manager's, and Owner's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
2. The geotechnical report is referenced in the Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Monitor dewatering systems continuously.

E. Promptly repair damages to adjacent facilities caused by dewatering.

F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Division 01 Section "Temporary Facilities and Controls" and Division 31 Section "Site Clearing" during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.

1. Maintain piezometric water level a minimum of 12 inches below surface of excavation.

E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.

1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 FIELD QUALITY CONTROL

A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 312319

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SECTION 315000 EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes temporary excavation support and protection systems.

B. Related Sections:

1. Division 01 Section "Construction Progress Documentation and Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
2. Division 01 Section "Temporary Facilities and Controls" for temporary utilities and support facilities.
3. Division 31 Section "Dewatering" for dewatering system for excavations.

1.3 PERFORMANCE REQUIREMENTS

A. Lay back trenches and excavation as required for site safety.

1.4 SUBMITTALS

A. Other Informational Submittals:

1. Photographs or Videotape: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.
2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.

   a. Note locations and capping depth of wells and well points.

1.5 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to excavation support and protection system including, but not limited to, the following:

   a. Geotechnical report.

b. Existing utilities and subsurface conditions.
c. Proposed excavations.
d. Proposed equipment.
e. Monitoring of excavation support and protection system.
f. Working area location and stability.
g. Coordination with waterproofing.
h. Abandonment or removal of excavation support and protection system.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Architect's, Construction Manager's, and Owner's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
2. The geotechnical report is referenced elsewhere in the Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlaying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Division 31 Section "Earth Moving."
3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000

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SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Hot-mix asphalt patching.
2. Hot-mix asphalt paving.
3. Asphalt surface treatments.
4. Pavement-marking paint.

B. Related Sections:

1. Division 02 Section "Structure Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.
2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
3. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices and as defined in Division 1.

1.4 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
2. Job-Mix Designs: For each job mix proposed for the Work.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Samples: For each paving fabric, 12 by 12 inches minimum if used.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each paving fabric, 12 by 12 inches minimum.
2. Each type and color of preformed traffic-calming device.
3. Each pattern and color of imprinted asphalt and precut marking material.

E. Qualification Data: For qualified manufacturer and Installer.

F. Material Certificates: For each paving material, from manufacturer.

G. Material Test Reports: For each paving material.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide copy of manufactures experience for verification of qualifications.

B. Installer Qualifications: Imprinted-asphalt manufacturer's authorized installer who is trained and approved for installation of imprinted asphalt required for this Project.

C. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

D. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of city and DOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

E. Preinstallation Conference: Conduct conference at Project site

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review condition of subgrade and preparatory work.
c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F. Not used if paving takes place within 48 hours of final grading and final compaction of road base.
2. Tack Coat: Minimum surface temperature of 60 deg F.
3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Cement: AC 20 per ASTM D 3381 for viscosity-graded material except use ductility at 39.2 deg. F., >5 for AC 20 and delete the loss on heating requirement on residue from “Thin-Film Oven Test”.

B. Prime Coat: Not required if paving is done within 48 hours of final compaction.

C. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

D. Fog Seal: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

E. Water: Potable.

F. Undersealing Asphalt: ASTM D 3141, pumping consistency.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.

C. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

D. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type I Type II or III Type IV, hot-applied, single-component, polymer-modified bituminous sealant.

E. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N, Type F, and Type S; colors complying with FS TT-P-1952.

1. Color: White, Yellow, Blue, and as indicated.

F. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.

1. Color: White, Yellow, Blue, and As indicated.

G. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.

1. Color: White, Yellow, Blue, and As indicated.

H. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

1. Color: White, Yellow, Blue, and As indicated.

I. Glass Beads: AASHTO M 247, Type 1.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located. Provide mix with the following characteristics:
   a. Number of compaction blows each end of specimen: 50.
   b. Satiability based on ASTM D5581: 1200 minimum.
   c. Flow in 0.01-inch units per ASTM D5581: 10-18.
   d. Voids in mineral aggregate VMA: 14.
   e. The percentage of bituminous material by weight added to aggregate will be between 4% and 7% of the weight of the bituminous mixture.

2. Surface Course: 3-inch minimum compacted thickness and as indicated on the drawings with aggregate meeting the following gradation table. Note, temporary paving will have less asphalt paving thickness.

¾ inch	100
½ inch	74-99
3/8 inch	69-91
No. 4	49-65
No. 8	33-47
No. 16	21-35
No. 50	6-18
No. 200	2-6

B. Emulsified-Asphalt Slurry: ASTM D 3910, Type 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Verify that the road base has been properly compacted and is at the correct line, grade, and slope.

C. Verify that the road base thickness is as indicated on the project plans.

D. Verify that sufficient depth at curbs, walks, lips and other vertical edges is available to place the required thickness of compacted asphalt.

E. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons or other vehicle with similar axel weight.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

F. Proceed with paving only after unsatisfactory conditions have been corrected.

G. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Not used.

C. Prime Coat: Not use if paving takes place not more than 48 hours after final compaction and grading of road bases. If paving must be delayed significantly, re-grade and re-compact road base or apply Prime Coat. Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings.
3. Remove and replace items damaged by overspray or clean affected surfaces as directed by architect at no additional cost to owner.

3.5 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt surface course in single lift if design thickness is less than 3-inches. If design thickness is more than 3-inches, place in multiple lifts with a minimum thickness of 1.5-inches and a maximum thickness of 3-inches.
2. Spread mix at minimum temperature of 250 deg F.
3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations.".
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 94 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 92 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Place asphalt so that final compacted asphalt is even with lip of gutter on curbs that drain away from the curb and gutter (open face or depressed curb and gutter). Place asphalt so that final compacted asphalt is 1/4-inch above lip of gutter on curbs that carry water (slope of parking lot is towards the curb). In transition areas, use extra care to make sure that no ponds, bird baths, or depressions are left after paving.

G. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

H. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

I. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   1. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
   1. Surface Course: 1/8 inch.
   2. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

C. After paving is complete, pour water on paved areas and identify ponds, bird baths, and depressions. Identify the same at open face and transition sections of curb and gutter. Remove and replace asphalt, curb and gutter, road base, and or sub-base as necessary to fix ponds, bird baths, or depressions at no additional cost to owner.

3.9 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow curing.

   1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 7 days minimum days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

   1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

E. Color
   1. Yellow: Parking stalls and pedestrian crossings.
   2. Blue: Handicap insignia at appropriate stalls.
   3. Red: Fire lanes and no parking areas.
   4. White: Directional arrows.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726. Cores will also be measured for compacted thickness. The owner and architect may also direct additional cores to be taken at locations of their choosing to verify final pavement thickness.

   a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
   b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
   c. Coordinate the time and locations of all holes so that cores may be filled.

E. The contractor will replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.12 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.

END OF SECTION - 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Driveways and roadways.
2. Parking lots.
3. Curbs and gutters.
4. Walkways.
5. Unit paver base.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
3. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Qualification Data: For manufacturer and testing agency.

D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

E. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

F. Field quality-control test reports.

G. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

E. Mockups: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Obtain Architect's approval of mockups before starting construction.
4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
5. Demolish and remove approved mockups from the site when directed by Architect.

6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete producer.
d. Concrete pavement subcontractor.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves with a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:

1. Portland Cement and as specified in Division 3 except that for exterior concrete, the minimum compressive strength is 4000 psi at 28 days.

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

1. Products:

a. Monofilament Fibers:

1) Axim Concrete Technologies; Fibrasol IIP.
2) Euclid Chemical Company (The); Fiberstrand 100.
3) FORTA Corporation; Forta Mono.
4) Grace, W. R. & Co.--Conn.; Grace MicroFiber.
5) Metalcrete Industries; Polystrand 1000.
6) SI Concrete Systems; Fibermix Stealth.
7) Or engineer approved equal.

b. Fibrillated Fibers:

1) Axim Concrete Technologies; Fibrasol F.

2) FORTA Corporation; Forta.
3) Euclid Chemical Company (The); Fiberstrand F.
4) Grace, W. R. & Co.--Conn.; Grace Fibers.
5) SI Concrete Systems; Fibermesh.
6) Or engineer approved equal.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

1. Products:

a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edeco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambco Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, ChemRex Inc.; Confilm.
k. Meadows, W. R., Inc.; Sealtight Evapre.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. Symons Corporation; Finishing Aid.
p. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
q. Or engineer approved equal.

E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

1. Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. Burke by Edoko; Aqua Resin Cure.
c. ChemMasters; Safe-Cure Clear.
d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
f. Euclid Chemical Company (The); Kurez DR VOX.
g. Kaufman Products, Inc.; Thinfilm 420.
h. Lambert Corporation; Aqua Kure-Clear.
i. L&M Construction Chemicals, Inc.; L&M Cure R.
j. Meadows, W. R., Inc.; 1100 Clear.

k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
l. Symons Corporation; Resi-Chem Clear.
m. Tamms Industries Inc.; Horncure WB 30.
n. Unitex; Hydro Cure 309.
o. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
p. Or engineer approved equal.

F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

1. Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 WP WB.
b. Burke by Edoco; Resin Emulsion White.
c. ChemMasters; Safe-Cure 2000.
d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
e. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
f. Euclid Chemical Company (The); Kurez VOX White Pigmented.
g. Kaufman Products, Inc.; Thinfilm 450.
h. Lambert Corporation; Aqua Kure-White.
i. L&M Construction Chemicals, Inc.; L&M Cure R-2.
j. Meadows, W. R., Inc.; 1200-White.
k. Symons Corporation; Resi-Chem White.
l. Tamms Industries, Inc.; Horncure 200-W.
m. Unitex; Hydro White.
n. Vexcon Chemicals, Inc.; Certi-Vex Enviocure White 100.
o. Or engineer approved equal.

2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:

1. Types types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Chemical Surface Retarder: Water-soluble, liquid-set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

1. Products:

a. Burke by Edeco; True Etch Surface Retarder.
b. ChemMasters; Exposee.
c. Conspec Marketing & Manufacturing Co., Inc.; Delay S.
d. Euclid Chemical Company (The); Surface Retarder S.

e. Kaufman Products, Inc.; Expose.
f. Metalcrete Industries; Surftard.
g. Nox-Crete Products Group, Kinsman Corporation; Crete-Nox TA.
h. Scofield, L. M. Company; Lithotex.
i. Sika Corporation, Inc.; Rugasol-S.
j. Vexcon Chemicals, Inc.; Certi-Vex Envioset.
k. Or engineer approved equal.

E. Pigmented Mineral Dry-Shake Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Products:

a. Conspec Marketing & Manufacturing Co., Inc.; Conshake 600 Colortone.
b. Dayton Superior Corporation; Quartz Tuff.
c. Euclid Chemical Company (The); Surflex.
d. Lambert Corporation; Colorhard.
e. L&M Construction Chemicals, Inc.; Quartz Plate FF.
f. MBT Protection and Repair, ChemRex Inc.; Mastercron.
g. Metalcrete Industries; Floor Quartz.
h. Scofield, L. M. Company; Lithochrome Color Hardener.
i. Symons Corporation; Hard Top.
j. Or engineer approved equal.

2. Color: Match Architect's sample or as selected by Architect from manufacturer's full range.

F. PentraSil 244+: Per BYU Standards.

2.7 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with FS TT-P-115, Type I or II or AASHTO M 248, Type N or F.

1. Color: White, Yellow, Blue. See Section 321216 for color locations.

B. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than 45 minutes.

1. Color: White, Yellow, Blue. See Section 321216 for color locations.

C. Glass Beads: AASHTO M 247, Type 1.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45
3. Select slump limit from options in subparagraph below or revise to suit Project.
4. Slump Limit: 4 inches, plus or minus 1 inch.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 5-8 percent nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture, high-range, water-reducing admixture, high-range, water-reducing and retarding admixture, plasticizing, and retarding admixture in concrete, as required, for placement and workability.

2. Specify admixtures as part of submittal. Verify that admixtures proposed do not adversely effect stained concrete and will not modify colors of stain.

3. Coordinate acceptability of admixtures with architect.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements as follows:

1. Fly Ash or Pozzolan: 25 percent.
2. Ground Granulated Blast-Furnace Slag: 50 percent.
3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

G. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd. in all exterior concrete.

H. Color Stain: Add stain to concrete per manufacturers recommendations and to meet color required by architect and owner on areas of stained concrete.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete mixes of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete mixes larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons or similar axel weight vehicle.
3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
   1. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   2. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

   1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
   2. Extend joint fillers full width and depth of joint.
   3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
   4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
   5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site.

F. Do not add water to fresh concrete after testing.

G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

I. Screed pavement surfaces with a straightedge and strike off.

J. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

K. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

L. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.

M. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

N. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.

2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

O. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
4. Coordinate with architect the locations of each type of finish.

3.7 SPECIAL FINISHES

A. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to pavement surface according to manufacturer's written instructions and as follows:

1. Uniformly spread dry-shake hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer to match pavement color required.
2. Uniformly distribute approximately two-thirds of dry-shake hardener over pavement surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second dry-shake hardener application, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed by power floating.
3. After final floating, apply a hand-trowel finish followed by a broom finish to concrete.

4. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.

B. Coordinate the locations of finishes with the architect and owner prior to placing concrete.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete pavement to cure for 14 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Spread glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or 5000 sq. ft. or fraction thereof of each concrete mix placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.

a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION – 321313

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SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Expansion and contraction joints within cement concrete pavement.
2. Joints between cement concrete and asphalt pavement.

B. Related Sections include the following:

1. Division 07 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.
2. Division 32 Section "Asphalt Paving" for constructing joints between concrete and asphalt pavement.
3. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

D. Qualification Data: For installer and testing agency.

E. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than six (6) pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the commencement of the Work.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 for testing indicated, as documented according to ASTM E 548.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
3. When joint substrates are wet or covered with frost.
4. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 COLD-APPLIED JOINT SEALANTS

A. Multicomponent Jet-Fuel-Resistant Sealant for Concrete: Pourable, chemically curing elastomeric formulation complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated:

1. Urethane Formulation: Type M; Grade P; Class 12-1/2; Uses T, M, and, as applicable to joint substrates indicated, O.

   a. Available Products:

      1) Pecora Corporation; Urexpan NR-300.
      2) Engineer approved equal.

2. Coal-Tar-Modified Polymer Formulation: Type M; Grade P; Class 25; Uses T and, as applicable to joint substrates indicated, O.

   a. Available Products:

      1) Meadows, W. R., Inc.; Sealtight Gardox.
      2) Engineer Approved Equal.

3. Bitumen-Modified Urethane Formulation: Type M; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.

   a. Available Products:

      1) Tremco Sealant/Waterproofing Division; Vulkem 202.
      2) Engineer approved Equal.

B. Single-Component Jet-Fuel-Resistant Urethane Sealant for Concrete: Single-component, pourable, coal-tar-modified, urethane formulation complying with ASTM C 920 for Type S; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.

1. Available Products:

a. Sonneborn, Div. of ChemRex, Inc.; Sonomeric 1.
b. Engineer Approved Equal.

C. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.

1. Available Products:

a. Crafco Inc.; RoadSaver Silicone.
b. Dow Corning Corporation; 888.
c. Engineer Approved Equal.

D. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

1. Available Products:

a. Crafco Inc.; RoadSaver Silicone SL.
b. Dow Corning Corporation; 890-SL.
c. Engineer Approved Equal.

E. Multicomponent Low-Modulus Sealant for Concrete and Asphalt: Proprietary formulation consisting of reactive petropolymer and activator components producing a pourable, self-leveling sealant.

1. Available Products:

a. Meadows, W. R., Inc.; Sof-Seal.
b. Engineer Approved Equal.

2.4 HOT-APPLIED JOINT SEALANTS

A. Jet-Fuel-Resistant Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3569.

1. Available Products:

a. Crafco Inc.; Superseal 444/777.
b. Meadows, W. R., Inc.; Poly-Jet 3569.
c. Engineer Approved Equal.

B. Jet-Fuel-Resistant Sealant for Concrete and Tar Concrete: Single-component formulation complying with ASTM D 3581.

1. Available Products:

a. Crafco Inc.; Superseal 1614A.

b. Meadows, W. R., Inc.; Poly-Jet 1614.
c. Meadows, W. R., Inc.; Poly-Jet 3406.
d. Meadows, W. R., Inc.; Poly-Jet 3569.
e. Engineer Approved Equal.

C. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.

1. Available Products:

a. Crafco Inc.; Superseal 444/777.
b. Meadows, W. R., Inc.; Poly-Jet 3406.
c. Engineer Approved Equal.

D. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.

1. Available Products:

a. Koch Materials Company; Product No. 9005.
b. Koch Materials Company; Product No. 9030.
c. Meadows, W. R., Inc.; Sealtight Hi-Spec.
d. Engineer Approved Equal.

2.5 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.6 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION – 321373

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SECTION 321400 - UNIT PAVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Concrete pavers – pedestal mounted
   2. Cementitious fill of the pedestal assembly where required by the manufacturer.
   3. Pavers installed over waterproofing membrane applications are provided by the waterproofing manufacturer for single-source responsibility of the entire system

B. Related Sections include the following:
   1. Division 7 Section "Waterproofing" for waterproofing and protection board under pavers.

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Concrete pavers.
   2. Pedestal mounts
   3. Cementitious fill for pedestals

B. Samples for Initial Selection: Samples showing the full range of color, and textures available for type of unit paver indicated.

C. Samples for Verification: Full-size units of type of unit paver indicated; in sets for texture, color variation, showing the full range of variations expected in these characteristics.

   1. Provide Samples with saw cut surface joints in patterns showing the full range of base color variation to be expected in the completed Work.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed unit paver installations similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain each type of unit paver, and pedestal support from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

C. Mockups: Before installing unit pavers, build mockups for each form and pattern of unit pavers required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work, including same base construction, special features for expansion joints, and contiguous work as indicated:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Include typical sawed joint unit that will serve as a border for contrasting field applied colors
5. Obtain Architect's approval of mockups before starting unit paver installation.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect unit pavers during storage and construction against soiling or contamination from earth and other materials.

1. Cover pavers with plastic or use other packaging materials that will prevent rust marks from steel strapping.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.6 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar and Grout: Comply with the following requirements:

1. Cold-Weather Requirements: Protect unit paver work against freezing when atmospheric temperature is 40 deg F (4 deg C) and falling. Heat materials to provide mortar and grout temperatures between 40 and 120 deg F (4 and 49 deg C). Provide the following protection for completed portions of work for 24 hours after installation when the mean daily air temperature is as indicated: below 40 deg F (4 deg C), cover with weather-resistant membrane; below 25 deg F (minus 4 deg C), cover with insulating blankets; below 20 deg F (minus 7 deg C), provide enclosure and temporary heat to maintain temperature above 32 deg F (0 deg C).
2. Hot-Weather Requirements: Protect unit paver work when temperature and humidity conditions produce excessive evaporation of fill materials. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and higher.

a. When ambient temperature exceeds 100 or 90 deg F (38 or 32 deg C) with a wind velocity greater than 8 mph (13 km/h), set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Concrete Pavers:
   a. Licensee of American Hydrotech
   b. Licensee of Carlisle Inc
   c. Licensee of PermaQuik

2.2 COLORS AND TEXTURES

A. Colors and Textures: Unfinished concrete, smooth troweled finish. Color as selected by Architect.

2.3 UNIT PAVERS

A. Concrete Pavers: Solid, 24 x 24 units, 2” thick, ASTM C 936, made from normal-weight aggregates.

2.4 ACCESSORIES

A. Panel lifting device: Manufacturers standard one or two person device fabricated to grasp panel edges in joint space and lift paver.

2.5 PEDESTAL SUPPORT SYSTEM

A. Manufacturers standard telescoping, graduated step system or tab and shim system as standard with unit paver manufacturer for substrates required.

B. Include joint spacer tabs at each corner pedestal to maintain uniform joint spacing throughout installation.

2.6 GROUT MATERIALS – FOR PEDESTAL FILL

A. Latex-Portland Cement Grout: ANSI A118.6, composition as follows:

1. Packaged, dry grout mix consisting of portland cement, graded aggregate, and ethylene vinyl acetate in the form of a reemulsifiable powder to which only water is added at Project site.

B. Water: Potable.

2.7 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce materials of uniform quality and with optimum performance characteristics. Discard mortars and grout when they have reached their initial set.

B. Latex-Modified Portland Cement Grout: Add latex additive to dry grout mix in proportion and concentration recommended by latex-additive manufacturer. Proportion cement and aggregate to comply with directions of latex-additive manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Examine waterproofing installation for protection from paving operations. Examine areas where waterproofing system is turned up or flashed against vertical surfaces and horizontal waterproofing. Proceed with installation only after protection is in place.

3.2 PREPARATION

A. Vacuum clean substrates to remove dirt, dust, debris, and loose particles.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible or cause staining in finished work.

B. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

C. Joint Pattern: **As indicated**.

D. Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and repair damaged waterproofing before covering with paving.

E. Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.

3.4 PEDESTAL MOUNTED ASSEMBLIES

A. Set Pedestals at spacing as recommended by manufacturer.

B. Depending upon type of pedestal provided, utilize shims, extension rings, or extension plates above or below pedestal body to raise top of pedestal to elevation required.

C. For extended pedestals, check level laterally and longitudinally for proper level.

D. Fill center of pedestal with cement grout mixture as recommended by manufacturer to stabilize in-place pedestal.

E. Finish top of pedestal flush and set tab spacing plate to maintain paver alignment

3.5 REPAIR, POINTING, CLEANING, AND PROTECTION

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. At areas indicated, fill sawed joints with sealant.

C. Cleaning: Remove excess sealer from exposed paver surfaces; wash and scrub clean.

1. Remove protective coating as recommended by protective coating manufacturer and acceptable to unit paver and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

END OF SECTION 02780

SECTION 321443 - POROUS UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Porous paving consisting of concrete pavers set in aggregate setting beds.

B. Related Sections include the following:

1. Division 32 Section "Earthwork" for excavation and compacted subgrade.
2. Division 32 Section "Cement Concrete Pavement" for cast-in-place concrete curbs that serve as edge restraints for porous paving.
3. Division 32 Section "Exterior Plants" for ground cover planted in porous paving.

1.3 SUBMITTALS

A. Product Data: For materials other than aggregates.

B. Product Data: For the following:

1. Pavers.
2. Edge restraints.
3. Geotextiles

C. Sieve Analyses: For aggregate materials, according to ASTM C 136.

D. Samples for Initial Selection:

1. Each type of unit paver indicated.
2. Aggregate fill.

E. Samples for Verification:

1. Full-size units of each type of unit paver indicated.
2. Exposed edge restraints.
3. Aggregate fill.

F. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.

1. For grid paving units, include durability test data performed on units subjected to three years' exposure to same general type of environment, temperature range, and traffic volume as expected for Project.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of porous paver from one source that has resources to provide materials and products of consistent quality in appearance and physical properties.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

PART 2 - PRODUCTS

2.1 CONCRETE UNIT PAVERS

A. Solid Concrete Pavers for Porous Paving: Solid interlocking paving units of shapes that provide openings between units, complying with ASTM C 936**, resistant to freezing and thawing when tested according to ASTM C 67**, and made from normal-weight aggregates.

1. Products: Subject to compliance with requirements, provide products by one of the following:
   a. RCP Turf Block
   b. AirVolBlock
   c. Belgard Turfstone
   d. Amcor turfstone
   e. Lehi Block Turfstone

2. Thickness: **3-1/8 inches (80 mm)**
3. Face Size and Shape: 23 5/8 x 15 3/4.
4. Color: Natural

2.2 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Subbase: Sound crushed stone or gravel complying with **requirements in Division 32 Section "Earthwork" for subbase material**.

B. Graded Aggregate for Base Course: Sound crushed stone or gravel complying with **requirements in Division 32 Section "Earthwork" for base-course material**.

C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.

D. Soil Mix for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate blended with planting soil mix complying with requirements in Division 32 Section "**Lawns and Grasses**

E. Graded Aggregate for Leveling Course: Sound crushed stone or gravel complying with ASTM D 448 for Size No. **8**.

F. Soil for Porous Paver Fill: Planting soil mix complying with requirements in Division 32 Section "**Lawns and Grasses**."

G. Sod: Cut sod plugs as specified in Division 32 section.

H. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
3. Permittivity: 0.02 per second, minimum; ASTM D 4491.
4. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

PART 3 - EXECUTION

3.1 PREPARATION

A. Proof-roll prepared subgrade according to requirements in Division 2 Section "Earthwork" to identify soft pockets and areas of excess yielding. Proceed with porous paver installation only after deficient subgrades have been corrected and are ready to receive **subbase and base** course for porous paving.

3.2 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be structurally unsound or visible in finished work.

B. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

C. Tolerances:

1. Variation in Plane between Adjacent Units (Lipping): Do not exceed 1/16-inch (1.5-mm) unit-to-unit offset from flush.
2. Variation from Level or Indicated Slope: Do not exceed 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) or a maximum of 1/2 inch (13 mm).

3.3 SETTING-BED INSTALLATION

A. Compact soil subgrade uniformly to at least **95** percent of **ASTM D 698** laboratory density.

B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Place **separation** geotextile over prepared subgrade, overlapping ends and edges at least 12 inches (300 mm).

D. Place aggregate **subbase and base**, compact by tamping with plate vibrator, and screed to depth indicated.

E. Place aggregate **subbase and base**, compact to 98 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.

F. Place geotextile over compacted base course, overlapping ends and edges at least 12 inches (300 mm).

G. Place leveling course and screed to a thickness of **1 to 1-1/2 inches (25 to 38 mm)**, taking care that moisture content remains constant and density is loose and constant until pavers are set and compacted.

3.4 PAVER INSTALLATION

A. Set unit pavers on leveling course, being careful not to disturb leveling base. If pavers have lugs or spacer bars to control spacing, place pavers hand tight against lugs or spacer bars. If pavers do not have lugs or spacer bars, place pavers with a 1/16-inch- (1.6-mm-) minimum and 1/8-inch- (3.2-mm-) maximum joint width. Use string lines to keep straight lines. Fill gaps between units that exceed **3/8 inch (10 mm)** with pieces cut to fit from full-size pavers.

1. When installation is performed with mechanical equipment, use only unit pavers with lugs or spacer bars on sides of each unit.

B. Compact pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.

1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches (900 mm) of uncompacted pavers adjacent to temporary edges.
2. Before ending each day's work, compact installed concrete pavers except for 36-inch (900 mm) width of uncompacted pavers adjacent to temporary edges (laying faces).
3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches (90 mm) of laying face.

4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.

C. Place soil fill as follows, immediately after vibrating pavers into leveling course. Spread and screed soil fill level with tops of pavers. Vibrate pavers and add soil fill until porous paving is filled to about 3/4 inch (19 mm) from top surface; remove excess soil fill if any.

1. Before ending each day's work, place soil fill in installed porous paving except for 42-inch (1067-mm) width of unfilled paving adjacent to temporary edges (laying faces).
2. As work progresses to perimeter of installation, place soil fill in installed paving that is adjacent to permanent edges unless it is within 42 inches (1067 mm) of laying face.
3. Before ending each day's work and when rain interrupts work, cover paving that has not been filled with nonstaining plastic sheets to protect it from rain.

D. After filling pavers with soil, hydroseed to comply with the Division 329200 Section "Lawns and Grasses,". water with fine spray.

E. Remove and replace pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

3.5 MAINTENANCE AND PROTECTION

A. Water newly planted grass and keep moist until grass is established. Maintain grass that is planted in paving to comply with requirements in Division 2 Section "Lawns and Grasses."

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades for **30** days after planting.

END OF SECTION 321443

SECTION 02860 SITE SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Providing post-mounted site traffic signage where indicated.

B. Related Documents: Conditions of the Contract, General Requirements, and Drawings apply to the Work of this Section.

C. Related Sections:
1. Asphalt Concrete Paving: Section 321216
2. Cement Concrete Paving: Section 321313

1.2 SUBMITTALS

A. General: Submit the following:

B. Product Data: Manufacturer's data for each type of sign and post indicated.

C. Manufacturer’s installation instruction, for information only.

1.3 QUALITY ASSURANCE

A. Manufacturer shall have a minimum of five years experience in the manufacturing of traffic signage of the type specified for this Project.

B. Codes and Standards: Comply with the City Building Code, latest edition, and other requirements of authorities having jurisdiction.

1.4 PRODUCT DELIVERY

A. Deliver materials in factory packages with factory labels attached.

B. Cover and protect material in transit and at job site. Damaged or defaced material will be rejected and shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide traffic sign with post where shown on the Drawings and as specified.

2.2 MATERIALS

A. Signs: 0.080 aluminum sheet.

B. Posts: Galvanized Steel flanged channels weighing 4 pounds per foot, length as required for proper mounting height and scheduled foundation embedment depth.

C. Bolts, Nuts, Washers, and Clamps: Cadmium or galvanized steel. Bolts shall be a minimum of 5/16" in diameter. Clamps shall be two-piece assemblies of at last 14 gage steel or shall be an adjustable steel strap bracket.

D. Concrete for foundations: 2500 psi minimum, complying with Section 321313.

E. Concrete for mow strip: 3000 psi minimum, complying with Section 321313.

2.3 SCHEDULE

A. Handicapped Parking Sign Type 1: 12" x 18", 18 gage steel sheet with baked enamel finish. Sign to have handicapped symbol and text reading "Reserved For Handicapped".

B. Handicapped Parking Sign Type 2: 12" x 18", 18 gage steel sheet with baked enamel finish. Sign to have handicapped symbol and text reading "Reserved For Handicapped – Van Accessible".

C. Fire Lane Sign: 12" x 18", 18 gage steel sheet with baked enamel finish. Sign to have text reading "No Parking – Fire Lane".

D. No Parking Sign: 12” x 22”, 18 gage steel sheet with baked enamel finish. Text as indicated on Drawings.

E. Fuel Efficient Parking Sign Type: 12" x 18", 18 gage steel sheet with baked enamel finish. Sign to have text reading "Reserved High Fuel Efficient Vehicles Only".

F. Service Vehicle Parking Sign Type: 12" x 18", 18 gage steel sheet with baked enamel finish. Sign to have text reading "Service Vehicles Parking Only".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete.

B. Provide forms where required due to unstable soil conditions and for perimeter of sign pole base at grade. Secure and brace forms and foundation tube, sleeve, or anchor bolts in position, to prevent displacement during concreting.

C. Place concrete immediately after mixing. Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven days or use nonstaining curing compound.

D. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base. Construct exposed concrete surface (mow strip) in landscape areas with grass or hardscape areas (asphalt or concrete). In landscape areas without grass, do not construct mow strip.

3.3 INSTALLATION

A. Install signs in accordance with manufacturer's drawings, shop drawings, and specifications.

B. Install sign posts and sign panels plumb, level, and square and in proper planes with other work.

C. Anchor sign panels securely to sign posts, using fasteners suitable for application and as recommended by manufacturer.

3.4 FIELD QUALITY CONTROL

A. Verify that signs are installed in accordance with manufacturer's instructions.
B. Tolerances:
   1. Out of level: ± 1/8".
   2. Out of plumb: ± 1/4".

3.5 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 322000

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SECTION 323119 - ORNAMENTAL METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Decorative steel fences.
   2. Swing gates.

B. Related Sections:

   1. Division 32 Section "Earthwork" for site excavation, fill, and backfill where decorative metal fences and gates are located.
   2. Division 3 Section "Cast-in-Place Concrete" for concrete post concrete fill.

1.3 PERFORMANCE REQUIREMENTS

A. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For gates. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each fence material and for each color specified.

   1. Provide Samples 12 inches (300 mm) in length for linear materials.
   2. Provide Samples 12 inches (300 mm) square for bar grating.

D. Welding certificates.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for decorative metallic-coated steel tubular picket fences, including finish, indicating compliance with referenced standard and other specified requirements.

F. Maintenance Data: For gate operators to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel"

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. UL Standard: Provide gate operators that comply with UL 325.

E. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators on gates that must provide emergency access.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation].

1. Include 10-foot (3-m) length of fence complying with requirements.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 STEEL AND IRON

A. Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.

C. Tubing: ASTM A 500, cold formed steel tubing.

D. Bar Grating: NAAMM MBG 531.

1. Bars: Hot-rolled steel strip, ASTM A 1011/A 1011M, Commercial Steel, Type B.
2. Wire Rods: ASTM A 510 (ASTM A 510M).

E. Castings: Either gray or malleable iron unless otherwise indicated.

1. Gray Iron: ASTM A 48/A 48M, Class 30.
2. Malleable Iron: ASTM A 47/A 47M.

2.2 COATING MATERIALS

A. Epoxy Zinc-Rich Primer for Steel: Complying with MPI #20 and compatible with coating specified to be applied over it.

1. Products: Subject to compliance with requirements, provide manufacturer's standard product.

B. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

1. Products: Subject to compliance with requirements, Provide menufacturer's standard product.

C. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

1. Products: Subject to compliance with requirements, provide manufacturer's standard product

2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Division 3 Section "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi (20 MPa), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum aggregate size.

C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 and specifically recommended by manufacturer for exterior applications.

2.4 GROUNDING MATERIALS

A. Grounding Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

1. Material above Finished Grade: Copper.
2. Material on or below Finished Grade: Copper.
3. Bonding Jumpers: Braided copper tape, 1 inch (25 mm) wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.

B. Grounding Connectors and Grounding Rods: Comply with UL 467.

1. Connectors for Below-Grade Use: Exothermic-welded type.
2. Grounding Rods: Copper-clad steel.

a. Size: 5/8 by 96 inches (16 by 2440 mm).

2.5 DECORATIVE GALVANIZED STEEL FENCES

A. Decorative Steel Fences: Fences made from steel tubing bars and shapes.

1. Manufacturers: Subject to compliance with requirements, provide the following to comply with campus standard:

a. Master Halco; "Montage plus Ornamental Fence – Majestic 3 Rail Flat Rail top"

B. Posts: Square steel tubing; manufacturer's standard.

C. Post Caps: Manufacturer's standard

D. Infill: Manufacturer's standard.

E. Fasteners: Stainless-steel carriage bolts and tamperproof nuts.

F. Fabrication: Assemble fences into sections by welding pickets to rails or as standard with manufacturer.

G. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.

1. Hot-dip galvanize posts and rails.
2. Hot-dip galvanize rail and picket assemblies after fabrication.

H. Finish for Bar Grating Infill: Powder coating.

I. Finish for Metallic-Coated Steel Items: High-performance coating.

2.6 SWING GATES

A. Gate Configuration: Single leaf.

B. Gate Frame Height: 72 inches (1830 mm).

C. Gate Opening Width: As indicated.

D. Galvanized-Steel Frames and Bracing: Manufacturer' standard.

E. Steel Frames and Bracing: Manufacturer's standard.]

F. Frame Corner Construction: Manufacturer's standard.

G. Infill: Comply with requirements for adjacent fence.

H. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.

I. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet (1.52 m) wide. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.

J. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M unless otherwise indicated. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.

K. Metallic-Coated Steel Finish: High-performance coating.

2.7 METALLIC-COATED STEEL FINISHES

A. Galvanized Finish: Clean welds, mechanical connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

B. High-Performance Coating: Apply epoxy primer, epoxy intermediate coat, and polyurethane topcoat to prepared surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

1. Construction layout and field engineering are specified in Division 1 Section "Execution Requirements."

3.3 DECORATIVE FENCE INSTALLATION

A. Install fences according to manufacturer's written instructions.

B. Install fences by setting posts as indicated and fastening rails and infill panels to posts.[Peen threads of bolts after assembly to prevent removal.

C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches (600 mm) plus 3 inches (75 mm) for each foot (300 mm) or fraction of a foot (300 mm) that fence height exceeds 4 feet (1200 mm).

D. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts and sleeves and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

a. Exposed Concrete: Extend 2 inches (50 mm) above grade. Finish and slope top surface to drain water away from post.

3. Posts Set into Concrete in Sleeves: Use galvanized-steel pipe sleeves with inside diameter at least 3/4 inch (20 mm) larger than outside diagonal dimension of post, preset and anchored into concrete for installing posts.

a. Extend posts at least 5 inches (125 mm) into sleeve.
b. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions; shape and smooth to shed water. Finish and slope top surface of grout to drain water away from post.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 GROUNDING AND BONDING

A. Fence Grounding: Install at maximum intervals of 1500 feet (450 m) or at least once except as follows:

1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet (225 m).

a. Gates and Other Fence Openings: Ground fence on each side of opening.

1) Bond metal gates to gate posts.
2) Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.

B. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.

C. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location.

D. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

E. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

F. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.6 FIELD QUALITY CONTROL

A. Grounding-Resistance Testing: Owner will engage a qualified testing agency to perform tests and inspections.

1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
3. Report: Prepare test reports certified by a testing agency of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.7 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 323119

SECTION 323230 – BOULDERS

PART 1 - GENERAL:

1.1 RELATED DOCUMENTS:

The general provisions of the Contract, including General and Supplementary conditions and General Requirements, if any, apply to the work specified in this Section.

1.2 SUMMARY:

A. Large scale boulders for landscaping features

B Related work

Division 32 Section for	Irrigation Sprinkler System
Division 32 Section for	Landscape Planting

1.3 DESCRIPTION OF WORK:

1. Provide and install large boulders from off -site source.
2. Remove debris and clean premises.

1.4 VERIFICATION OF DIMENSIONS AND QUANTITIES:

A. All scaled dimensions are approximate. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions, and shall immediately inform the Architect of any discrepancy between the information on the Drawings and actual conditions, refraining from doing any work on said areas until given approval to do so by the Architect.

1.5 SUBMITTALS:

A. General: Submit each item in this article according to the conditions of the Contract and Division 1 specification section.

1.6 QUALITY ASSURANCE

A. Standard for installation is established by the boulder wall in place at Belltower Plaza on the campus. Arrangement, alignment, spacing are all desired for this work as reflected in the work in place.

B. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 1 Section "Quality Requirements" for mockups.

1. Build sample panels for **60 inches** **high** by 10 feet in length

2. Approval of sample panels is for color, blending of boulders ; relationship of boulders to each other and aesthetic qualities of placement and workmanship.

1.7 PERMITS AND UTILITIES:

A. The Contractor shall be responsible for location and protection of all utilities prior to commencing the work. The Contractor shall contact Blue Stakes for exact locations of all utilities.

1.8 JOB CONDITIONS:

A. During the progress of work, the Contractor shall be responsible for keeping the premises clean by removing all rubbish, waste materials, or other debris from the site at the completion of each working day. All such material shall be disposed of properly and/or as directed by the Owner.

B. Contractor should note that roads, parking areas and sidewalks in project areas will be chemically treated in winter to prevent icing and should take whatever precautions are necessary to see that plant materials are not adversely affected by this chemical treatment.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Materials shall be obtained from the designated quarry and shall be approved by the Architect. All materials furnished for the work shall conform in every respect to the approved sample.

1. Boulders: Native stone
   a.: Size Range: 60” maximum, 30” minimum.

PART 3 - EXECUTION:

3.1 EXAMINATION

A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface drainage shall be insured, and if shown, shall be directed in the manner indicated on the Drawing of plot plan by molding the surface to facilitate the natural run-off water. Fill low spots and pockets with soil and grade to drain properly.

3.3 INSTALLATION

A. Provide and install clean boulders as detailed and as shown in the Site Drawings.

B. Installation of boulders shall not adversely affect underground piping or conduit in the immediate area of installation. Freefall of boulders shall be limited to avoid shock to adjacent structures.

C. Boulders shall be place in an aligned and consistent plane following a uniform line

3.4 CLEANUP AND PROTECTION

A. During sitework, keep pavements clean and work area in an orderly condition.

B. Protect work from damage due to sitework operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged work as directed.

3.5 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION

SECTION 328400 – IRRIGATION SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes valves, piping, sprinklers, specialties, accessories, controls, and wiring for irrigation systems.

B. Field verify capacity of the existing irrigation system complete including but not limited to flow, capacity, controller operation and etc.

C. Remodel the existing system adjacent to new construction as required to revise 100% coverage between the new and existing system.

D. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section 011000 - Scope of Work.
2. Specification Section – Soils Report for reference only.
3. Division 2 Section 329300 - Landscape Planting.
4. Division 26 Sections for electrical power materials and installations.

1.3 DEFINITIONS

A. Piping sizes used in this Section are normal pipe size (NPS) in inches. Tube sizes are standard size in inches. Equivalent SI (metric) sizes are indicated in millimeters (mm) in parentheses.

B. Supply Piping: Piping from water source to connection to irrigation system pressure piping. Piping is under same pressure as water supply. Piping in this category is not included in this Section.

C. Pressure Piping: Piping downstream from supply piping to and including control valves. Piping is under irrigation system pressure. Piping in this category includes pressure regulators, water meters, and backflow preventers, when used.

D. Circuit Piping: Piping downstream from control valves to irrigation system sprinklers, emitters, devices, and drain valves. Piping is under pressure (less than pressure piping) during flow.

E. Control Valve: Manual or automatic (electrically operated) valve for control water flow to irrigation system zone, including isolation or zone valves.

F. Drain Piping: Downstream from circuit or pressure piping drain valves. Piping is not under pressure.

G. Drain Valve: Manual drain valve for draining of irrigation system circuit piping.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Location of Sprinkler and Devices: Design location is approximate. Make minor adjustments necessary to avoid planting and obstructions such as signs and light standards.

B. Minimum Water Coverage: Not less than:

1. Turf Areas: 100 percent.
2. Other Planting Areas: 100 percent.

C. Components and Installation: Capable of producing piping systems with the following minimum working pressure ratings except where indicated otherwise.

1. Pressure Piping: 150 psig (1035 kPa).
2. Circuit and Drain Piping: 100 psig (690 kPa).

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data including pressure rating, rated capacity, settings, and electrical data of selected models for the following:
1. Pressure regulators.
2. Valves, including general-duty, underground, manual and automatic control, and quick-coupler types, and valve boxes.
3. Sprinklers, including emitters, drip tubes, and devices.
4. Controls, including radio control, antennae and controller wiring diagrams.
5. Wiring.
6. Pipe, including sleeves, lateral, supply, conduit and drain.
7. Master Valve
8. Landscape Water Meter
9. Automatic Filters

C. Wiring diagrams for electrical controllers, valves, and devices.

D. Maintenance data for inclusion in “Operating and Maintenance Manual” specified in Division 1 Section “Project Closeout” for the following:
1. Pressure regulators.
2. Automatic control valves.
3. Sprinklers.
4. Controllers and Radio Control Equipment.
5. Central Control Equipment.
6. Automatic Filters.
7. Master Valve
8. Landscape Water Meter

E. Irrigation Schedule: A monthly Irrigation Schedule shall be prepared that covers the initial 120-day plant establishment period and the typical long-term use period. This schedule shall consist of a table with the following information for each valve:

1. Plant type (for example, turf, trees, low water use plants);
2. Irrigation type (for example, sprinklers, drip, bubblers);
3. Flow rate in gallons per minute;
4. Precipitation rate in inches per hour (sprinklers only);
5. Run time in minutes per day;
6. Number of water days per week, and
7. Cycle time to avoid runoff.

The irrigation schedule shall rely on the estimated landscape water use calculations and shall be adjusted as necessary for irrigation efficiency, soil conditions, slope, and microclimate conditions. (See Appendix C-1, C-2)

F. Water Use Efficiency Review: Following construction a Water Use Efficiency Review (Audit) will be conducted by a certified Landscape Irrigation Auditor. The auditor shall be independent of the contractor, design firm and owner / developer of the project. The water performance audit will verify that the irrigation system complies with the minimum standards required by this ordinance. The auditor shall furnish a certificate to the DFCM, Landscape Architect and installer certifying compliance with the minimum distribution requirements and an irrigation schedule.

G. Substantial Completion Form – Appendix C

1.6 QUALITY ASSURANCE

A. Comply with requirements of utility supplying water for prevention of backflow and backsiphonage.

B. Comply with requirements of authority with jurisdiction for irrigation systems.

C. Installer Qualifications: Engage an experienced installer who has completed minimum of 6 irrigation systems similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

D. Listing/Approval Stamp, Label, or Other Marking: On equipment, specialties, and accessories made to specified standards.

E. Listing and Labeling: Equipment, specialties, and accessories that are listed and labeled.

1. The Terms “Listed” and “Labeled”: As defined in “National Electrical Code,” Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

F. Product Options: Irrigation system piping, specialties, and accessories are based on specific types, manufacturers, and models indicated. Components with equal performance characteristics produced by other manufacturers may be considered, provided deviations in dimensions, operation, and other characteristics do not change design concept or intended performance as judged by the Architect, unless noted “No Substitute”. The burden of proof of product equality is on the Contractor. Refer to Division 1 Section “Product Substitutions.” No requests for substitutions will be reviewed after bids have been received by Owner.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Verify that irrigation system piping may be installed in compliance with original design and referenced standards.

B. Site Information: Reports on subsurface condition investigations made during design of the Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions (between soil borings). Owner assumes no responsibility for interpretations or conclusions drawn from this information.

1.8 SEQUENCING AND SCHEDULING

A. Maintain uninterrupted water service to building during normal working hours. Arrange for temporary water shutoff with Owner.

B. Coordinate irrigation systems work with landscape work specified in Division 2 Section 02900 - Landscape Planting.

1.9 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below. Package them with protective covering for storage and label clearly describing contents.

1. Quick Couplers: Furnish quantity of units equal to 10% of amount of each size installed, but not less than 1.
2. Sprinklers: Furnish quantity of units equal to 10% of amount of each type installed, but not less than 10.
3. Dripper Tube: Furnish quantity of units equal to 10% of amount of each type installed.
4. Valve Keys: Furnish quantity of tee-handle units equal to 25% of amount of each type key-operated, control valve installed, but not less than 2 each.
5. Quick Coupler Hose Swivels: Furnish quantity of units equal to 25% of amount of each type quick coupler installed, but not less than 2.
6. Quick Coupler Operating Keys: Furnish quantity of units equal to 25% of amount of each type quick coupler installed, but not less than 3.

1.10 WARRANTY/GUARANTEE

A. During the period of one (1) year from and after the final acceptance of the completed irrigation system, the Contractor shall at his own expense, make all needed repairs or replacement due to defective workmanship or materials which in the judgement of the Owner or Owner's representative, shall become necessary during such period. If, within seven (7) calendar days after mailing of the written notice or verified communication by the Owner to the Contractor or his agent, requesting such repairs or replacement, the Contractor shall neglect to make repairs, Owner may make such repairs at the Contractor's expense. In the case of emergency where, in the judgement of the Owner, delay could cause serious loss, hazard or damage to persons or property, then repairs, replacement and security, both temporary and/or permanent, may be provided by such persons as the Owner may employ, after verbal communication with

Contractor without notice being sent to the Contractor, and the Contractor shall pay all costs related thereto.

B. The guarantee shall be in the form of a letter from the Contractor addressed to the Owner. The letter shall incorporate the language stated above and be signed by an authorized officer/agent or Owner of the Contractor.

C. During the guarantee period, the Contractor will drain the system in the fall and put the system back into operation in the Spring. This work shall be done in the presence of the Owner's representative and maintenance personnel.

1.11 RECORD DRAWINGS:

A. Any deviation from plan layout should be indicated on the final "Record" Drawings. This Contractor shall make an exact measured and dimensioned drawing showing locations of all piping, wiring, control, valves and quick coupler valves.

B. Record Drawings shall be furnished to the Landscape Architect at the time of Substantial Completion Inspection before a letter of Substantial Completion for the irrigation sprinkler system will be issued.

C. The Contractor shall supply the Landscape Architect with record drawing information in AutoCadd format before final acceptance of the irrigation system. The following shall be included on Irrigation Record Drawings. In addition, provide a reduced color-coded drawing(s) showing all zones and assigned valves.

1. Note all points of connection (P.O.C.) include tap size, line size and static water pressure (P.S.I.) of service.

2. Provide name and phone number of the servicing water purveyor include the name and date the installer was completed and the date the as-built drawing was approved.

3. Accurately locate the following major components by dimension and their size as installed on the project. (But not limited to the Following):

- Water Meters
- Backflow Preventers
- Pressure Reducing Valves (note pressure settings)
- Filters
- Stop and Waste
- Master Control Valves
- Control wire junction boxes
- Pumps
- Flow Sensors
- Remote Control Valves (note station assignment, size flow rate, pressure setting. D.U. and actual flow rates. If available from water audit).
- Drip System Pressure Regulators and Filters
- Quick Couplers and Hose Bibs
- Pressure Main Lines and Future P.O.C.'s
- Manual Drain Valves and Sumps
- Remote Control Wire (label both ends and in junction box)
- Controller Location(s) (Note manufacturer, model, size and number of station used)
- Central Control
- Rain Sensors
- Moisture Sensors

- Note and identify location(s) of existing utility systems as encountered during installation, i.e.; gas, phone, sewer, etc.
- Air Release Valves

4. Indicate and show the following additional components installed on the project:

- All Sprinkler Heads
- Lateral Lines and sizes
- Lateral Lines Sleeves and sizes
- Manual or Automatic Flush Valves

1.12 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver irrigation system components in manufacturer's original undamaged and unopened containers with labels intact and legible.

B. Deliver plastic piping in bundles, packaged to provide adequate protection of pipe ends, both threaded or plain.

C. Store and handle materials to prevent damage and deterioration.

D. Provide secure, locked storage for valves, sprinkler heads, and similar components that cannot be immediately replaced, to prevent installation delays.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pressure Regulators/Master Valve
   a. Raphael Industries.
   b. Bermad.
   c. Conbraco Industries, Inc.
   d. Watts Regulator Co.
   e. Wilkins Regulator Div., Zurn Industries, Inc.
2. Gate Valves for Underground Installation:
   a. Nibco, Inc.
   b. Clow Valve Co. Div., McWane, Inc.
   c. Kennedy Valve Div., McWane, Inc.
   d. Stockham Valves & Fittings, Inc.
   e. Waterous Co.
3. Corporation Stops for Underground Installation
   a. Ford Meter Box Co., Inc.
   b. Hays Div., Romac Industries.
   c. A.Y. McDonald Mfg. Co.
   d. Mueller Co., Grinnell Corp.
4. Valves for Aboveground and Pit Installation
   a. Grinnell Supply Sales Co., Grinnell Corp.

b. Nibco, Inc.
c. Stockham Valves & Fittings, Inc.
d. Walworth Co.
e. Watts Regulator Co.

5. Automatic Control Valves
   a. Rain Bird Sprinkler Mfg. Corp.
6. Control Valve Boxes
   a. Ametek by Plymouth Products Div., AMETEK
   b. Brooks Products, Inc., Polyplastics Div.
   c. Carson Industries, inc.
   d. DFW/HPI by Hefco Plastics, Inc.
   e. National Diversified Sales, Inc.
7. Quick Couplers
   a. Rain Bird Sprinkler Mfg. Corp.
8. Sprinklers
   a. Hunter Industries.
   b. Rain Bird Sprinkler Mfg. Corp.
9. Dripper Tubes, and Devices
   a. Rain Bird Sprinkler Mfg. Corp.
   b. Netafim, Inc.
10. Controllers
    a. Rain Master Irrigation Systems (Proprietary)
11. Pipe
    a. Pacific Western Extruded Plastics Co.
    b. Eagle Pacific Industries, Inc.
    c. J-M Manufacturing Company, Inc.
12. Automatic Filters
    a. Amiad Filtration Systems (No Substitute)
13. Master Valve
    a. Netafim (Proprietary)

2.2 PIPES AND TUBES

A. Refer to Part 3 Article “Piping Applications” for identification of systems where pipe and tube materials specified below are used.

B. Polyvinyl Chloride (PVC) Plastic Pipe: ASTM D 1785, PVC 1120, Schedule 40, 160 psig (1100 kPa) minimum pressure rating for 3-inch (100-mm) and smaller sizes, with plain, threaded or bell ends.

   1. PVC Socket Fittings: Schedule 40: ASTM D 2466.

C. Polyvinyl Chloride (PVC) Plastic Pipe: ASTM D 1785, PVC 1120 compound, Schedule 80.

   1. PVC Socket Fittings: Schedule 80: ASTM D 2467.

   2. PVC Threaded Fittings: Schedule 80: ASTM D 2464.

D. PVC, Pressure-Rated Pipe: ASTM D 2241, PVC 1120 compound, SDR 21 Bell and Ring for pipe 4” and larger.

2.3 PIPE AND TUBE FITTINGS

A. Refer to Part 3 Article “Piping Applications” for identification of systems where pipe and tube fitting materials specified below are used.

B. Cast-Bronze Flanges: ASME B16.24, Class 150, raised ground face, bolt holes spot faced.

C. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D2467, Schedule 80, socket-type and ASTM D2464, Schedule 80, threaded fittings.

D. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D2467, Schedule 40, socket-type and ASTM D2464, Schedule 40, threaded fittings.

E. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D2241, PVC 1120 compound, SDR 21.

F. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D2467, Schedule 40, socket-type.

G. Ductile Iron: Deep Socket Cast Iron Fittings: ASTM A536.

H. Mechanical Joint: Mechanical Joint Steel Fittings: AWWA A21.10

2.4 JOINING MATERIALS

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods” for joining materials not included in this Section.

B. Solvent Cement: ASTM F656 primer and ASTM D2564 solvent cement in color other than orange.

C. Gaskets for Plastic Flanged Joints: Materials recommended by plastic pipe and fittings manufacturer.

D. Gaskets for Plastic Joints: Trans gaskets as recommended the fittings manufacturer.

2.5 VALVES

A. General: Valves are for general-duty and underground applications. Refer to “Valve Applications” Article for locations of various valve types specified in this Article. Refer to “Control Valves” Article for control valves and accessories and “Backflow Preventers” Article for backflow preventer valves.

B. Nonrising Stem Gate Valves 3-inches (DN 80) and Larger: AWWA C500, cast-iron double disc, bronze disc and seat rings or AWWA C509, resilient seated; bronze stem, cast-iron, or ductile-iron body and bonnet, stem nut, 200 psig (1380 kPa) working pressure; and ends that fit NPS dimension, PVC pipe. Include elastomeric gaskets.

C. Valve Boxes: Cast-iron box with top section and cover with lettering “WATER,” bottom section with base to fit over valve and barrel approximately 5-inches (127 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.

1. Provide steel tee-handle shutoff rod with each valve box. Include tee-handle, shutoff rod with one pointed end, stem of length to operate valve, and end fitting valve operating nut.

D. Curb Stops 2-inches (DN 50) and Smaller: Bronze body, ground key plug or ball, 150 psig (1035 kPa) minimum pressure rating, wide tee head, with inlet and outlet to match service piping material.

E. Service Boxes for Curb Stops: Cast-iron box with telescoping top section of length required for depth of bury of valve. Include cover with lettering "WATER" and bottom section with base of size to fit over curb stop and barrel approximately 3-inches (75 mm) in diameter.

1. Provide steel tee-handle shutoff rod with each service box. Include tee-handle, shutoff rod with one pointed end, stem of length to operate curb stop, and slotted end fitting curb stop head.

F. Bronze, Nonrising Stem Gate Valves, 2-inches (DN 50) and Smaller: MSS SP-80, Type 1, solid wedge; nonrising, copper-silicon-alloy stem; Class 125, body and screw bonnet of ASTM B 62 cast bronze, with threaded or solder-joint ends. Include polytetrafluoroethylene (PTFE) – impregnated packing, brass packing gland, and malleable-iron handwheel.

G. Plastic Valves: Polyvinyl Chloride (PVC) Plastic, with 150 psig (1035 kPa) minimum pressure rating, ends compatible to piping where valve is to be installed, and tee handle.

H. Ball Valves: Ball valves shall be solid bronze meeting Federal Specification WW-V-35C, TYPE II, COMPOSITION: BZ, STYLE: 3. Size shall be the same size as the main line on which it is installed. Valves shall be installed on the up-stream side of the electric remote control valve manifold and in the same valve box. NOTE: Only one (1) ball valve required per manifold.

I. Master Valve: Electric remote control operated valve. Class 125, Main valve and actuator cast iron ASTM A 126 class B with built in flow sensor.

J. Drain Valves: All drain valves shall be ¾" brass full turn ball cocks and installed as per details on the Drawings. Valves shall be tested for 150 psi working pressure. This valve is to be installed on mainlines only.

2.6 CONTROL VALVES

A. Description: Manufacturer's standard control vales for circuits, of type and size indicated, and as follows:

1. Provide cast-bronze bodies, unless otherwise indicated.
2. Manual Control Valves: MSS SP-80, Class 125, globe valves.
3. Key-Operated, Manual Control Valves: MSS Sp-80, Class 125, globe valves, fitted for key operation.
4. Automatic Control Valves: Diaphragm-type, normally closed, with manual flow adjustment, and operated by 24-volt-a.c. solenoid.
5. Automatic Drain Valves: Designed to open for drainage when line pressure drops below 3 psig (20 kPa). Not for use on pressure piping.
6. Quick-Couplers: Factory-fabricated, 2-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, ¾-11.5NH Threads for garden hose on outlet; and operating key.
   a. Locking Top Option: Include vandal-resistant, locking feature with two matching keys.

B. Control Valve Boxes: Polyethylene (PE), acrylonitrile-butadiene-styrene (ABS), fiberglass, polymer concrete, or precast concrete box and cover. Size as required for application.

1. Drainage Backfill: Cleaned gravel or crushed stone, graded form 3-inches (75 mm) maximum to ¾-inch (19 mm) minimum.

2. Valve boxes shall be of sufficient size to house two (2) electric remote control valves with unions, and still allow room for maintenance without having to excavate or perform similar operations. Boxes shall have lock down lids and shall meet ASTM D638 for tensile strength of 4,300 pounds per square inch.

C. Service Boxes for Key-Operated Control Valves: Cast-iron box with telescoping top section of length required for depth of bury of valve. Include cover with lettering "WATER," and bottom section with base of size to fit over curb stop and barrel approximately 3-inches (75 mm) in diameter.

1. Include valve key, 36-inches (915 mm) long with tee handle and key end to fit valve.

2.7 MASTER VALVE

A. Provide a Netafim 6" normally closed hydrometer compatible with the Rainmaster DX48 Controller.

2.8 FILTER

A. Provide an Amiad 6" 2-0420-1110-4030 super steel inline filter assembly with brushaway cleaning system and weavewire screen (130 micron) in aluminum enclosure. Install a 2" automatic valve for flushing of the system. Tie to storm drain.

2.9 SPRINKLERS

A. Description: Manufacturer's standard sprinklers designed to provide uniform coverage over entire area of spray shown on Drawings at available water pressure, as follows:

1. Housings: plastic, except where material is specified.

2. Pop-up, Spray: Fixed pattern, with screw-type flow adjustment and stainless steel retraction spring.

3. Pop-up, Rotary Spray: Gear drive, full-circle and adjustable part-circle type.

4. Bubblers: Fixed pattern, with screw type flow adjustment.

2.10 AUTOMATIC CONTROL SYSTEM

A. Description: Low-voltage controller system made for control of irrigation system automatic control valves. Controller operates on 120 volts a.c. building power system, provides 24 volts a.c. power to control valves.

B. Exterior Control Enclosures: Weatherproof enclosure with locking cover and two matching keys. Enclosure construction complies with NFPA 70 and NEMA 250, Type 4, and includes provision for grounding.

1. Material: Enameled-steel, sheet metal.

C. Transformer: Internal-type, and suitable for converting 120 volts a.c. building power to 24 volts a.c. power.

D. Controller Stations for Automatic Control Valves: Include switch for manual or automatic operation of each station.

E. Timing Device: Adjustable, 24-hour, 14-day clock to operate any time of day. See Irrigation Schedule and Legend for model and manufacturer.

F. Lightning Protection: Provide manufacturer's standard lightning protection on each controller. Coordinate with electrical.

G. Wiring: UL 493, solid copper conductor, insulated cable, suitable for direct burial.

1. Feeder Circuit Cables: Type UF, No. 14 AWG minimum, between valves and controllers.

2. Control Wiring: Rain Master approved signal communication wire, Type PE39 or approved equal.

H. Valve wire sizing chart: See Appendix A at end of section.

I. Rainmaster controller to have the following equipment and as specified in the irrigation legend:

1. EV - Ground-Rod.
2. FSB
3. (2) PMR CAC
4. QP – 18D
5. ETHR
6. LPP
7. HWB

J. Verify the RAC code (frequency) and the CAC code (number) on the receiver with WSU personnel. Prior to ordering the ether net card verify the IP number address.

2.11 IDENTIFICATION

A. Refer to Division 2 Section "Earthwork" for plastic underground warning tapes.

2.12 THRUST BLOCKS

A. All main lines shall have a thrust block of poured concrete installed at each change of direction. The thrust block shall be of sufficient size for the pipe involved and rest on undisturbed ground. Construct as follows:

STEP 1.

Multiply the working pressure by the appropriate value shown in the following table to obtain total thrust in N (lb.):

PIPELINE THRUST FACTORS * ^

Pipe size in.	mm	Dead end or tee	90º elbow	45º elbow	22º elbow
3”	89	9.80	13.90	7.51	3.82
3 1/2”	102	12.80	18.10	9.81	4.99
4”	114	16.20	23.00	12.40	6.31
5”	141	24.70	35.00	18.90	9.63
6”	168	34.80	49.20	26.70	13.60
8”	219	59.00	83.50	45.20	23.00
10”	273	91.50	130.00	70.00	35.80
12”	324	129.00	182.00	98.50	50.30

* Based on thrust per kPa (PSI) pressure.
^ Blocking for cross may not be needed with long branch lines.

STEP 2.

Determine the bearing strength of the soil from the table below:

BEARING STRENGTH OF SOILS

Soils and safe bearing loads	lb/ft5	kPa
Sound shale	10,000	500
Cemented gravel and sand difficult to pick	4,000	200
Coarse and fine compact sand	3,000	150
Medium clay - can be spaded	2,000	100
Soft clay	1,000	50
Muck	0	0

See Soils Report for soil type

STEP 3.

Divide the total thrust obtained in Step 1 by the bearing strength of the soil to get the area needed, m5(ft5).

SIDE THRUST ALTERNATIVE PROCEDURE

Pipe size in.	mm	Side thrust per degree. lb	N
3”	89	17.10	76.10
3 1/2”	102	22.40	99.60
4”	114	28.30	125.90
5”	141	43.10	191.70
6”	168	60.80	270.50
8”	219	103.00	458.20
10”	273	160.00	711.70
12”	324	225.00	1,000.80

* Based on side thrust per 689 kPa (100 PSI) pressure per degree of deflection.

NOTE: Multiply side thrust from table by degree of deflection times kPa (PSI) divided by 100 to obtain total side thrust in N(lb).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Investigate and determine available water supply, water pressure and flow characteristics.

3.2 PREPARATION

A. Set stakes or flags to identify proposed sprinkler locations. Obtain Architect's approval before excavation.

3.3 PAVING WORK

A. Cutting and patching of asphalt paving is specified in Division 2 Section "Hot-Mixed Asphalt Paving."

B. Cutting and patching of concrete paving is specified in Division 2 Section "Portland Cement Concrete Paving."

C. Install piping in sleeves where crossing sidewalks, roadways, parking lots, and railroads.

3.4 PIPING APPLICATIONS

A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping in pits and aboveground may be joined with flanges instead of joints indicated.

B. Use pipe, tube, fittings, and joining methods according to the following applications.

C. Pressure Piping Underground: Use the following:

1. 3-inches (DN 80) and Smaller: ASTM D 1785, Schedule 40, polyvinyl chloride (PVC) plastic pipe; ASTM D 2466, Schedule 40, PVC plastic, socket-type pipe fittings; and solvent-cemented joints.

2. 3-inches (DN 80) and Larger: ASTM D 2241, Class 200, polyvinyl chloride (PVC) plastic pipe; with flanged or deep socket fittings.

D. Circuit Piping: Use the following:

1. All Sizes: ASTM D 1785, Schedule 40, polyvinyl chloride (PVC) plastic pipe; ASTM D 2466, Schedule 40, PVC plastic, socket-type fittings; and solvent-cemented joints.

E. Branches and Offsets at Sprinkler and Devices: ASTM D 1785, Schedule 80, polyvinyl chloride (PVC) plastic pipe with threaded ends; ASTM D 2464, Schedule 80, PVC plastic, threaded fittings; and threaded joints.

F. Drain Piping: ASTM D 1485, Schedule 40, polyvinyl chloride (PVC) plastic pipe; ASTSM D 2466, Schedule 40 PVC plastic, socket-type fittings; and solvent-cemented joints.

G. Sleeves: ASTM D 1785, Schedule 40, polyvinyl chloride (PVC) plastic pipe; ASTM D 2466, Schedule 40, PVC plastic, socket-type fittings; and solvent-cemented joints.

3.5 JOINT CONSTRUCTION

A. Flanged Joints: Align flanges and install gaskets. Assemble joints by sequencing bolt tightening. Use lubricant on bolt threads.

B. Threaded Joints: Thread pipes with tapered pipe threads according to ASME B1.20.1, apply tape or joint compound, and apply wrench to valve ends into which pipes are being threaded.

C. Polyvinyl Chloride (PVC) Piping Gasketed Joints: Construct joints between underground AWWA-type, cast-iron valves and NPS PVC pipe; with elastomeric seals that fit pipe diameter and valve ends; and lubricant, according to ASTM D 3139.

D. Polyvinyl Chloride (PVC) Piping Solvent-Cemented Joints: Construction joints according to ASTM D 2672 and ASTM D 2855.

1. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling when joining plastic pipe and fittings with solvent cements.

3.6 PIPING SYSTEMS – COMMON REQUIREMENTS

A. General Locations and Arrangements: Drawings indicated general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, and in other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.

B. Install piping at a uniform slope of 6-inches per 100-feet (1:200) minimum, down to drain points.

C. Install components having pressure rating equal to or greater than system operating pressure.

D. Install piping free of sags and bends.

E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

F. Install fittings for changes in direction and branch connections.

G. Piping Connections: Except as otherwise indicated make piping connections as specified below.

1. Install unions, in piping 2-inches (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment having 2-inch (DN 50) or smaller threaded pipe connection.

2. Install flanges, in piping 2½-inches (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

3. Install dielectric fittings to connect piping of dissimilar metals.

3.7 TRENCHES:

A. Trenches shall be dug as wide and deep as necessary to properly place the sprinkling system according to the requirements herein. Any rock uncovered in this excavation shall not

be left in the backfill. All excess rock shall be removed from the site by this Contractor and legally disposed of off the property. All trenches shall be backfilled and compacted to insure no settling of the surface, after the lawn is planted.

B. If backfill soil is rocky or lumpy, protect the pipe and the pipe conduit with 8” of sand or loose, rock free, soil under, over and on sides of pipe. Avoid putting large rocks against pipe during backfilling operation.

C. All trenches must be compacted to 90% in 6” lifts and watered in. Lines from control valves shall be installed after topsoil is in place and properly graded.

D. This Contractor, in placing the sprinkling lines, etc., may uncover material not suitable for finished grading. This material shall be removed from the site by this Contractor. After the installation of the lines, the finished grading shall be smoothed over and restored to its original condition, using additional topsoil at this Contractor's expense, if this is necessary. The upper 6” of topsoil removed in the excavation of trenches for pipeline shall be conserved and kept separate from subsoil and reinstalled without mixing with other soil.

E. Trenches where more than one pipe is to be installed, a distance of 6” is to be maintained between each pipe.

F. All trenches are to be 12” away from all curbs, buildings and sidewalks. No exceptions.

3.8 PIPING INSTALLATION

A. Install underground polyvinyl chloride (PVC) plastic pipe according to ASTM D 2774.

B. Lay piping on solid sub-base, uniformly sloped without humps or depressions.

1. Slope circuit piping down toward drain valve minimum of ½-inch in 10-feet (1:240).
2. Install polyvinyl chloride (PVC) plastic pipe in dry weather when temperature is above 40 deg. F (4 deg. C). Allow joints to cure at least 24-hours at temperature above 40 deg. F (4 deg. C) before testing, unless otherwise recommended by manufacturer.

C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel and crushed stone, graded from 3-inches (75 mm) to ¾-inch (19mm) minimum, drain material to 12-inches (300 mm) below grade. Cover drain material with sheet of ASTM D 226, Type II, asphalt-saturated felt and backfill remainder with excavated material. Drain pocket to be minimum 6 cubic feet.

D. Minimum Cover: Provide following minimum cover over top of buried piping:

1. Pressure Piping: Greater depth of minimum of 24-inches (600 mm) below finished grade.
2. Circuit Piping: 15-inches (380 mm).
3. Drain Piping: 15-inches (380 mm).
4. Sleeves: 24-inches (600 mm).

E. Install piping under sidewalks and paving in sleeves.

3.9 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, following requirements apply:

1. Buried Valves 3-inches (DN 80) and Larger: AWWA, gate valves, non-rising stem, with stem nut and valve box.
2. Buried Valves 2-inches (DN 50) and Smaller: Bronze-body, curb stop, with tee head, service box and shutoff rod.

3.10 VALVE INSTALLATION

A. Valves: Install underground valves in valve boxes or pits.

1. Install valves and polyvinyl chloride (PVC) pipe with restrained, gasketed joints.

B. Curb Stops: Install underground curb stops in service boxes.

C. Control and Ball Valves: Install in valve control valve boxes, arranged for easy adjustment and removal. Install unions with one (1) on upstream side at each valve manifold.

3.11 MASTER VALVE

A. Install the master valve in the location shown as per manufacturers' literature and recommendations.

3.12 FILTER

A. Install the filter as per manufacturers' detail and recommendations inside the specified enclosure on a concrete pad.

3.13 PRESSURE REGULATOR INSTALLATION

A. Install pressure regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet and valved bypass where indicated.

3.14 SPRINKLER INSTALLATION

A. Sprinklers: Flush circuit piping with full head of water and install sprinklers after hydrostatic test is complete.

1. Install lawn sprinklers at manufacturer's recommended heights.
2. Install shrubbery sprinklers at heights indicated.
3. Locate part-circle sprinklers to maintain a minimum distance of 12-inches (400 mm) from walls and 2-inches (50 mm) from other boundaries, unless otherwise indicated.

3.15 AUTOMATIC CONTROL SYSTEM INSTALLATION

A. Install controllers, radio cards, and all specified equipment according to manufacturer's written instructions and as indicated.

B. Install controllers in NEMA 3 exterior cabinet. Provide and install concrete pad as shown.

C. Run one extra wire from the controller to each group of valves for future use and stub into the valve box.

D. Install control wiring in same trench with piping.

3.16 CONNECTIONS

A. Connect piping to sprinklers, devices, valves, control valves, specialties, and accessories.

B. Connect water supplies to irrigation systems. Include backflow preventers on potable water supplies. Include automatic filters on secondary water supplies.

C. Electrical Connections: Connect to power source, controllers, and automatic control valves.

B. Minimum requirements for electrical installations are specified in Division 16.

C. Ground systems according to Division 16 Section “Grounding.”

3.17 FIELD QUALITY CONTROL

A. Testing: Perform hydrostatic test of piping and valves before backfilling trenches. Piping may be tested in sections to expedite work.

1. Cap and subject the piping system to a static water pressure of 50 psig (345 kPa) above the operating pressure without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4-hours. Leaks and loss in test pressure constitute defects that must be repaired.
2. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
3. Notify Architect 24 hour in advance of pressure testing so test may be observed.

3.18 CLEANING AND ADJUSTING

A. Flush dirt and debris from piping before installing sprinklers and other devices.

B. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.

C. Carefully adjust lawn sprinklers so they will be flush with, or not more than ½-inch (13 mm) above, finish grade after completion of landscape work.

D. Adjust settings of controllers and automatic control valves.

3.19 COMMISSIONING

A. Starting Procedures: Follow manufacturer’s written procedures. If no procedures are prescribed by manufacturers, proceed as follows:

1. Verify that specialty vales and their accessories have been installed correctly and operate correctly.
2. Verify that specified test of piping are complete.
3. Check that sprinklers and devices are correct type.
4. Check that damaged sprinklers and devices have been replaced with new materials.
5. Check that potable water supplies have correct type backflow preventers.
6. Energize circuits to electrical equipment and devices.
7. Adjust operating controls.

B. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinklers are adjusted to final position.

C. Provide irrigation system layout and diagram in CADD format with water zones clearly identified. Layout to be color coded with a maximum of 5 colors for easy legibility. Record water budget for each irrigation control zone and current settings. Provide laminated copy and mount near controller. Verify location with Architect.

3.20 DEMONSTRATION

A. Demonstrate to Architect that system meets coverage requirements and that automatic controls function properly.

B. Demonstrate to Owner's maintenance personnel operation of equipment, sprinklers, specialties, and accessories. Review operating and maintenance information.

C. Provide 7-days' written notice in advance of demonstration.

APPENDIX A
ALLOWABLE AVERAGE DISTANCES FROM CONTROLLER TO VALVES

Load	Wire Sizes Common		8 WATT NO. 50 AND 150 22" - 3" NUMBER OF VALVES				7 WATT NO. 150 SERIES NUMBER OF VALVES				3.5 WATT NO. 50 / 150 NUMBER OF VALVES				3.1 WATT NO. 1825 / 1830 SERIES NUMBER OF VALVES			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
	16	16	1,440	720	480	360	1,630	810	540	400	4,950	2,470	1,650	1,230	3,050	1,520	1,010	760
	16	14	1,770	880	590	440	2,000	1,000	660	500	6,070	3,030	2,020	1,510	3,750	1,870	1,250	930
	16	12	2,070	1,030	690	510	2,340	1,170	780	580	7,090	3,540	2,360	1,770	4,370	2,180	1,450	1,090
	14	14	2,295	1,140	760	570	2,590	1,290	860	640	7,850	3,920	2,610	1,960	4,840	2,420	1,450	1,210
105V	14	12	2,820	1,410	930	700	3,190	1,590	1,060	790	9,640	4,820	3,210	2,410	5,950	2,970	1,980	1,480
	14	10	3,295	1,640	1,095	820	3,720	1,860	1,230	930	11,250	5,620	3,740	2,810	6,940	3,470	2,310	1,730
	12	12	3,660	1,830	1,215	910	4,130	2,060	1,370	1,030	12,500	6,250	4,160	3,120	7,710	3,850	2,560	1,920
	12	10	4,490	2,240	1,490	1,120	5,070	2,530	1,680	1,260	15,340	7,670	5,100	3,830	9,470	4,730	3,150	2,360
	10	10	5,810	2,900	1,930	1,450	6,560	3,280	2,160	1,640	19,860	9,930	6,610	4,960	12,600	6,130	4,080	3,060
	10	8	7,140	3,570	2,370	1,780	8,060	4,030	2,650	2,010	24,390	12,190	8,120	6,090	15,050	7,520	5,010	3,760
	16	16	1,670	830	550	410	1,910	950	630	470	5,400	2,700	1,800	1,350	2,360	1,180	780	590
	16	14	2,050	1,020	680	510	2,350	1,170	780	580	6,630	3,310	2,210	1,650	4,160	2,080	1,380	1,040
	16	12	2,400	1,200	800	600	2,740	1,370	910	680	7,740	3,870	2,580	1,930	4,860	2,430	1,620	1,210
	14	14	2,660	1,330	880	660	3,040	1,520	1,010	760	8,570	4,280	2,850	2,140	5,380	2,690	1,790	1,340
110V	14	12	3,260	1,630	1,080	810	3,730	1,860	1,240	930	10,500	5,250	3,500	2,620	6,610	3,300	2,200	1,650
	14	10	3,810	1,900	1,270	950	4,350	2,170	1,450	1,080	12,280	6,140	4,090	3,070	7,710	3,850	2,570	1,920
	12	12	4,230	2,110	1,410	1,050	4,830	2,410	1,610	1,200	13,640	6,820	4,540	3,400	8,570	4,280	2,850	2,140
	12	10	5,190	2,590	1,730	1,290	5,930	2,960	1,970	1,480	16,750	8,370	5,580	4,180	10,520	5,260	3,500	2,630
	10	10	6,720	3,360	2,240	1,680	7,660	3,830	2,550	1,910	21,680	10,800	7,220	5,420	13,620	6,810	4,540	3,400
	10	8	8,260	4,130	2,750	2,010	9,420	4,710	3,140	2,350	26,620	13,300	8,870	6,650	16,720	8,360	5,570	4,180
	16	16	1,960	980	650	490	2,260	1,130	750	560	5,980	2,990	1,990	1,490	3,900	1,950	1,300	970
	16	14	2,410	1,200	800	600	2,780	1,390	920	690	7,340	3,670	2,440	1,830	4,790	2,390	1,590	1,190
	16	12	2,810	1,400	930	700	3,240	1,620	1,080	810	8,570	4,280	2,850	2,140	5,590	2,790	1,860	1,390
	14	14	3,120	1,560	1,030	780	3,590	1,790	1,190	890	9,480	4,740	3,150	2,370	6,180	3,090	2,050	1,540
115V	14	12	3,830	1,910	1,270	950	4,410	2,200	1,470	1,100	11,650	5,820	3,880	2,910	7,800	3,800	2,530	1,900
	14	10	4,470	2,230	1,480	1,110	5,150	2,520	1,710	1,280	13,600	6,800	4,520	3,400	8,870	4,430	2,950	2,210
	12	12	4,960	2,480	1,650	1,240	5,720	2,860	1,900	1,430	15,100	7,550	5,020	3,770	9,860	4,930	3,280	2,460
	12	10	6,690	3,040	2,020	1,520	7,020	3,510	2,330	1,750	18,540	9,270	6,170	4,630	12,100	6,050	4,030	3,020
	10	10	7,890	3,940	2,620	1,970	9,090	4,540	3,020	2,270	24,000	12,000	7,990	6,000	15,660	7,830	5,210	3,910
	10	8	9,690	4,840	3,220	2,420	11,160	5,580	3,710	2,790	29,470	14,730	9,810	7,360	19,230	9,610	6,400	4,800
	16	16	2,170	1,080	720	540	2,510	1,250	830	620	6,394	3,190	2,130	1,590	4,240	2,120	1,410	1,060
	16	14	2,660	1,330	880	660	3,090	1,540	1,030	770	7,850	3,920	2,710	1,960	5,200	2,600	1,730	1,300
	16	12	3,110	1,550	1,030	770	3,600	1,800	1,200	900	9,170	4,580	3,050	2,290	6,070	3,030	2,020	1,510
	14	14	3,440	1,720	1,140	860	4,000	2,000	1,330	1,000	10,140	5,070	3,380	2,530	6,720	3,360	2,240	1,680
120V	14	12	4,230	2,110	1,410	1,050	4,900	2,450	1,630	1,220	12,450	6,220	4,150	3,110	8,260	4,130	2,750	2,060
	14	10	4,940	2,470	1,640	1,230	5,720	2,860	1,900	1,430	14,540	7,270	4,840	3,630	9,640	4,820	3,210	2,410
	12	12	5,490	2,740	1,830	1,370	6,360	3,180	2,120	1,590	16,140	8,070	5,380	4,030	10,720	5,360	3,570	2,680
	12	10	6,730	3,360	2,240	1,680	7,800	3,900	2,600	1,950	19,820	9,910	6,600	4,950	13,150	6,570	4,380	3,280
	10	10	8,720	4,360	2,900	2,180	10,100	5,050	3,360	2,520	25,660	12,830	8,550	6,410	17,020	8,510	5,670	4,250
	10	8	10,710	5,350	3,570	2,670	12,400	6,200	4,130	3,100	31,500	15,750	10,500	7,870	20,900	10,450	6,960	5,220
	16	16	2,380	1,190	790	590	2,770	1,380	920	690	5,980	2,990	1,990	1,490	4,750	2,370	1,580	1,180
	16	14	2,920	1,460	970	730	3,400	1,700	1,130	850	7,340	3,670	2,440	1,830	5,830	2,910	1,940	1,450
	16	12	3,410	1,700	1,130	850	3,970	1,980	1,320	990	8,570	4,280	2,850	2,140	6,800	3,400	2,260	1,700
	14	14	3,720	1,880	1,250	940	4,390	2,190	1,460	1,090	10,790	5,390	3,590	2,690	7,530	3,760	2,500	1,880
125V	14	12	4,640	2,320	1,540	1,160	5,400	2,700	1,790	1,350	13,260	6,630	4,410	3,310	9,250	4,620	3,080	2,310
	14	10	5,410	2,700	1,800	1,350	6,300	3,150	2,090	1,570	15,470	7,730	5,150	3,860	10,800	5,400	3,590	2,700
	12	12	6,010	3,000	2,000	1,500	6,990	3,490	2,320	1,740	17,180	8,590	5,720	4,290	12,000	6,000	3,990	3,000
	12	10	7,380	3,690	2,455	1,840	8,580	4,290	2,850	2,140	21,090	10,540	7,020	5,270	14,730	7,360	4,900	3,680
	10	10	9,550	4,770	3,180	2,380	11,110	5,550	3,690	2,770	27,310	13,650	9,090	6,820	19,070	9,530	6,350	4,760
	10	8	11,730	5,860	3,905	2,430	13,640	6,820	4,540	3,410	33,530	16,760	11,160	8,380	23,410	11,700	7,790	5,850

Appendix 'B' **Irrigation Schedule**

Project Name:	
Project Address:	
Prepared By:	
Company	
Telephone #	
Fax #	

Valve Station Number (A)	Plant Type (B)	Irrigation Type (C)	Flow Rate (D)	Precipitation Rate (E)	Initial Plant Establishment Period (4 Months)				Following One-Year Period (12 Months)											

Note: This irrigation schedule should be used as a guide. The landscaping should be monitored regularly and the schedule adjusted as needed for plant growth, local rainfall, and climate conditions. Check irrigation system frequently to minimize run off and over-spray. Schedule valves with sprinklers to irrigate between 6 PM and 10:00 AM to reduce water loss from wind and evaporation.

Jul	Month
15	Run time (minutes per day)
3	Run time (Days per week

Appendix 'C'

SUBSTANTIAL COMPLETION FORM

Project Name: _____

Project Address: _____

_____

I/We hereby certify the following:

1. The landscaping work for the above project has been completed in substantial conformance to the DFCM Landscape and Irrigation Standards (Guidelines)

2. The automatic controller has been set according to the approved irrigation schedule for the plant establishment period.

3. A Water Use Efficiency Review (audit) has been conducted on the completed landscape. The irrigation system has been adjusted to meet the minimum Irrigation Efficiency required by the DFCM and minimize overspray and runoff.

4. A copy of the irrigation schedule has been give to the property owner, and the DFCM.

5. A completed set of record drawings have been given to the DFCM.

Comments: _____

_____

_____

Substantial Completion Form prepared by:

Signature: _____ Date: _____

Company: _____ License No.: _____

Address: _____

_____

Telephone: _____

Water Use Efficiency Review (Audit) Certified by:

Signature: _____ Date: _____

Company: _____ License No.: _____

Address: _____

_____

Telephone: _____

END OF SECTION 02810

SECTION 328402 – POINT SOURCE DRIP IRRIGATION SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes valves, piping, drip tube, sprinklers, specialties and accessories for drip irrigation systems.

B. Field verify capacity of the existing irrigation system complete including but not limited to flow, capacity, controller operation and etc.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section SUMMARY.
2. Specification Section – Soils Report for reference only.
3. Division 32 Section Landscape Planting.
4. Division 32 Section Irrigation Sprinkling System.

1.3 DEFINITIONS

A. Piping sizes used in this Section are normal pipe size (NPS) in inches. Tube sizes are standard size in inches. Equivalent SI (metric) sizes are indicated in millimeters (mm) in parentheses.

B. Supply Piping: Piping from water source to connection to irrigation system pressure piping. Piping is under same pressure as water supply. Piping in this category is not included in this Section.

C. Pressure Piping: Piping downstream from supply piping to and including control valves. Piping is under irrigation system pressure. Piping in this category includes pressure regulators, water meters, and backflow preventers, when used.

D. Circuit Piping: Piping downstream from control valves to irrigation system sprinklers, emitters, devices, and drain valves. Piping is under pressure (less than pressure piping) during flow.

E. Control Valve: Manual or automatic (electrically operated) valve for control water flow to irrigation system zone, including isolation or zone valves.

F. Drain Valve: Automatic drain valve for draining of irrigation system circuit piping.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Location of Drip line, Emitters and Devices: Design location is approximate. Make minor adjustments necessary to avoid planting and obstructions such as signs and light standards.

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data including pressure rating, rated capacity, settings, and electrical data of selected models for the following:

1. Dripper line.
2. Pressure regulators.
3. Valves, including general-duty, underground, manual and automatic control, and quick-coupler types, and valve boxes.
4. Sprinklers and devices.
5. Flush Valves.
6. Filters.
7. Air/Vacuum Relief Valves
8. Pipe, including sleeves, lateral, supply, conduit and drain.
9. Emitters

C. Maintenance data for inclusion in “Operating and Maintenance Manual” specified in Division 1 Section “Project Closeout” for the following:

1. Dripper line.
2. Pressure regulators.
3. Valves, including general-duty, underground, manual and automatic control, and quick-coupler types, and valve boxes.
4. Sprinklers and devices.
5. Flush Valves.
6. Filters.
7. Air/Vacuum Relief Valves
8. Pipe, including sleeves, lateral, supply, conduit and drain.
9. Emitters

1.6 QUALITY ASSURANCE

A. Comply with requirements of utility supplying water for prevention of backflow and backsiphonage.

B. Comply with requirements of authority with jurisdiction for irrigation systems.

C. Installer Qualifications: Engage an experienced installer who has completed minimum of 6 irrigation systems similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

D. Listing/Approval Stamp, Label, or Other Marking: On equipment, specialties, and accessories made to specified standards.

E. Product Options: Irrigation system piping, specialties, and accessories are based on specific types, manufacturers, and models indicated. Components with equal performance characteristics produced by other manufacturers may be considered, provided deviations in dimensions, operation, and other characteristics do not change design concept or intended performance as judged by the Architect, unless noted “No Substitute”. The burden of proof of

product equality is on the Contractor. Refer to Division 1 Section "Product Substitutions." No requests for substitutions will be reviewed after bids have been received by Owner.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Verify that irrigation system piping may be installed in compliance with original design and referenced standards.

B. Site Information: Reports on subsurface condition investigations made during design of the Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions (between soil borings). Owner assumes no responsibility for interpretations or conclusions drawn from this information.

1.8 SEQUENCING AND SCHEDULING

A. Maintain uninterrupted water service to building during normal working hours. Arrange for temporary water shutoff with Owner.

B. Coordinate irrigation systems work with landscape work specified in Division 2 Section 02900 - Landscape Planting.

1.9 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below. Package them with protective covering for storage and label clearly describing contents.
   1. Flexible Risers and Single Source Emitters: Furnish quantity of units equal to 5% of amount of each type installed.

1.10 WARRANTY/GUARANTEE

A. During the period of one (1) year from and after the final acceptance of the completed irrigation system, the Contractor shall at his own expense, make all needed repairs or replacement due to defective workmanship or materials which in the judgement of the Owner or Owner's representative, shall become necessary during such period. If, within seven (7) calendar days after mailing of the written notice or verified communication by the Owner to the Contractor or his agent, requesting such repairs or replacement, the Contractor shall neglect to make repairs, Owner may make such repairs at the Contractor's expense. In the case of emergency where, in the judgement of the Owner, delay could cause serious loss, hazard or damage to persons or property, then repairs, replacement and security, both temporary and/or permanent, may be provided by such persons as the Owner may employ, after verbal communication with Contractor without notice being sent to the Contractor, and the Contractor shall pay all costs related thereto.

B. The guarantee shall be in the form of a letter from the Contractor addressed to the Owner. The letter shall incorporate the language stated above and be signed by an authorized officer/agent or Owner of the Contractor.

C. During the guarantee period, the Contractor will drain the system in the fall and put the system back into operation in the Spring. This work shall be done in the presence of the Owner's representative and maintenance personnel.

1.11 RECORD DRAWINGS:

A. Any deviation from plan layout should be indicated on the final "Record" Drawings. This Contractor shall make an exact measured and dimensioned drawing showing locations of all piping, wiring, control, valves and quick coupler valves.

B. Record Drawings shall be furnished to the Landscape Architect at the time of Substantial Completion Inspection before a letter of Substantial Completion for the irrigation sprinkler system will be issued.

C. The Contractor shall supply the Landscape Architect with record drawing information in AutoCadd format before final acceptance of the irrigation system.

1.12 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver irrigation system components in manufacturer's original undamaged and unopened containers with labels intact and legible.

B. Deliver plastic piping in bundles, packaged to provide adequate protection of pipe ends, both threaded or plain.

C. Store and handle materials to prevent damage and deterioration.

D. Provide secure, locked storage for valves, sprinkler heads, and similar components that cannot be immediately replaced, to prevent installation delays.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pressure Regulators
   a. Neta-Fim.
   b. Rain Bird Sprinkler Mfg. Corp.
   c. Weathermatic/Salco
   d. GPH Irrigation
2. Automatic Control Valves
   a. Rain Bird Sprinkler Mfg. Corp. (No Substitute)
3. Control Valve Boxes
   a. Ametek by Plymouth Products Div., AMETEK
   b. Brooks Products, Inc., Polyplastics Div.
   c. Carson Industries, inc.
   d. DFW/HPI by Hefco Plastics, Inc.
   e. National Diversified Sales, Inc.

4. Filters
   a. Rain Bird Sprinkler Mfg. Corp.
   b. Neta-Fim.
   c. Weathermatic/Salco
5. Flush Valves
   a. Rain Bird Sprinkler Mfg. Corp.
   b. Neta-Fim.
   c. Weathermatic/Salco
6. Air/Vacuum Relief Valves
   a. Rain Bird Sprinkler Mfg. Corp.
   b. Neta-Fim.
   c. Weathermatic/Salco
7. Pipe
   a. Pacific Western Extruded Plastics Co.
   b. Eagle Pacific Industries, Inc.
   c. J-M Manufacturing Company, Inc.
8. Flexible Risers and Emitters
   a. Weathermatic/Salco
   b. GPH Irrigation

2.2 PIPES AND TUBES

A. Refer to Part 3 Article “Piping Applications” for identification of systems where pipe and tube materials specified below are used.

B. Polyvinyl Chloride (PVC) Plastic Pipe: ASTM D 1785, PVC 1120, Schedule 40, 160 psig (1100 kPa) minimum pressure rating for 4-inch (100-mm) and smaller sizes, with plain, threaded or bell ends.

2.3 PIPE AND TUBE FITTINGS

A. Refer to Part 3 Article “Piping Applications” for identification of systems where pipe and tube fitting materials specified below are used.

B. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D2467, Schedule 40, socket-type and ASTM D2464, Schedule 40, threaded fittings.

C. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D2467, Schedule 40, socket-type.

2.4 JOINING MATERIALS

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods” for joining materials not included in this Section.

B. Solvent Cement: ASTM F656 primer and ASTM D2564 solvent cement in color other than orange.

C. Rainbird/Techline Fittings: Connections shall be made with approved Rainbird or Techline fittings.

2.5 VALVES

A. General: Valves are for general-duty and underground applications. Refer to "Valve Applications" Article for locations of various valve types specified in this Article. Refer to "Control Valves" Article for control valves and accessories and "Backflow Preventers" Article for backflow preventer valves.

B. Plastic Valves: Polyvinyl Chloride (PVC) Plastic, with 150 psig (1035 kPa) minimum pressure rating, ends compatible to piping where valve is to be installed, and tee handle.

C. Ball Valves: Ball valves shall be solid bronze meeting Federal Specification WW-V-35C, TYPE II, COMPOSITION: BZ, STYLE: 3. Size shall be the same size as the main line on which it is installed. Valves shall be installed on the up-stream side of the electric remote control valve manifold and in the same valve box. NOTE: Only one (1) ball valve required per manifold.

2.6 CONTROL VALVES

A. Description: Manufacturer's standard control vales for circuits, of type and size indicated, and as follows:

1. Provide cast-bronze bodies, unless otherwise indicated.
2. Manual Control Valves: MSS SP-80, Class 125, globe valves.
3. Key-Operated, Manual Control Valves: MSS Sp-80, Class 125, globe valves, fitted for key operation.
4. Automatic Control Valves: Diaphragm-type, normally closed, with manual flow adjustment, and operated by 24-volt-a.c. solenoid.
5. Automatic Drain Valves: Designed to open for drainage when line pressure drops below 3 psig (20 kPa). Not for use on pressure piping.
6. Quick-Couplers: Factory-fabricated, 2-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, ¾-11.5NH Threads for garden hose on outlet; and operating key.
   a. Locking Top Option: Include vandal-resistant, locking feature with two matching keys.

B. Control Valve boxes: Polyethylene (PE), acrylonitrile-butadiene-styrene (ABS), fiberglass, polymer concrete, or precast concrete box and cover. Size as required for application.

1. Drainage Backfill: Cleaned gravel or crushed stone, graded form 3-inches (75 mm) maximum to ¾-inch (19 mm) minimum.

2. Valve boxes shall be of sufficient size to house two (2) electric remote control valves with unions, and still allow room for maintenance without having to excavate or perform similar operations. Boxes shall have lock down lids and shall meet ASTM D638 for tensile strength of 4,300 pounds per square inch.

2.7 FLEXIBLE RISERS AND POINT SOURCE EMITTERS

A. Description: Manufacturer's standard risers and emitters as follows:
   1. Flexible riser assemblies shall consist of two high-impact, UV-resistant ½" male iron pipe thread PVC adapters solvent welded to algae-resistant ½" flexible PVC tubing manufactured to cut length of 12", 18" or 24". PVC male adapters shall be available in molded camouflage colors of Mulch (M), Desert (D), Grey Granite (G) or purple (R) for

reclaimed applications. Algae-resistant PVC hose shall be extruded using integrally compounded algae-resistant S-0214 material. Hose shall comply with ASTM F-21-70* (Fungus Testing) and ASTM G-42* (Algal Testing) and shall be uniformly black in color, smooth inside and outside, free of foreign material contamination and have no cracks, pinholes, dents, wrinkles or blisters. All hose shall be clearly marked "algae resistant" on the outer tube wall.

2. Emitters shall be manufactured from high-impact, UV-inhibited engineering grade plastics for use in point source irrigation applications. The inlet of the emitter shall be threaded with one half inch female threads so that it may be screwed onto a standard one-half inch male threaded fitting or nipple. Flow rates of one-half, one, two or four gallons per hour shall be clearly marked in GPH and color-coded for easy identification.

3.
4. Each outlet of each emitter shall be fully compensated and self flushing with a difusser cap. The outlet of the emitter shall have a a separate silicone elastomer control element to provide pressure compensation..

2.8 DRIP LINE AND INTEGRAL DRIPPER LINE COMPONENTS

The dripperline shall be Techline pressure compensating dripperline with check valve as manufactured by Netafim irrigation, Inc. Dripper flow rate spacing shall be as indicated on drawings.

1. Techline: All Techline connections shall be made with approved Techline insert fittings.

2. Soil Staples (TLS6): All on-surface/under mulch Techline/Techlite installations shall be held in place with Techline Soil Staples spaced evenly every 3' to 5' on center, and with two staples on each change of location.

3. Line Flushing Valves: All techline systems shall be installed with Netafim Automatic Line Flushing Valves as indicated on drawings.

4. Air/Vacuum Relief Valves: Each independent subsurface irrigation zone shall be installed with an Air/Vacuum Relief Valve as indicated at the zones highest point(s).

5. Pressure Regulator: A pressure regulator shall be installed at each zone valve to ensure operating pressures do not exceed system requirements. The pressure regulator shall be a Rainbird Pressure Regulator. Model number as indicated on drawings.

6. Disc Filter: A disc filter shall be installed at each zone valve or on the main line to ensure proper filtration. The filter shall be a Rainbird Basket Filter, Model number and mesh as indicated on drawings.

7. Multi - Outlet Emitter: Rainbird pressure compensating multi-outlet emitters as per Rainbird Manufacturing Corporation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Investigate and determine available water supply, water pressure and flow characteristics.

3.2 PIPING APPLICATIONS

A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping in pits and aboveground may be joined with flanges instead of joints indicated.

B. Use pipe, tube, fittings, and joining methods according to the manufacturers specification and the following applications.

C. Circuit Piping: Use the following:
   1. 3-inces (DN 80) and Smaller: ASTM D 2241, SDR 17, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 80, PVC plastic, socket-type pipe fittings; and solvent-cemented joints.

D. Branches and Offsets at Sprinkler and Devices: ASTM D 1785, Schedule 80, polyvinyl chloride (PVC) plastic pipe with threaded ends; ASTM D 2464, Schedule 80, PVC plastic, threaded fittings; and threaded joints.

E. Sleeves: ASTM D 1785, Schedule 40, polyvinyl chloride (PVC) plastic pipe; ASTM D 2466, Schedule 40, PVC plastic, socket-type fittings; and solvent-cemented joints.

3.3 JOINT CONSTRUCTION

A. Polyvinyl Chloride (PVC) Piping Solvent-Cemented Joints: Construction joints according to ASTM D 2672 and ASTM D 2855.

   1. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling when joining plastic pipe and fittings with solvent cements.

3.4 PIPING SYSTEMS – COMMON REQUIREMENTS

A. General Locations and Arrangements: Drawings indicated general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, and in other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.

B. Install piping at a uniform slope of 6-inches per 100-feet (1:200) minimum, down to drain points.

C. Install components having pressure rating equal to or greater than system operating pressure.

D. Install piping free of sags and bends.

E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

F. Install fittings for changes in direction and branch connections.

G. Piping Connections: Except as otherwise indicated make piping connections as specified below.

1. Install unions, in piping 2-inches (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment having 2-inch (DN 50) or smaller threaded pipe connection.

3.7 TRENCHES:

A. Trenches shall be dug as wide and deep as necessary to properly place the sprinkling system according to the requirements herein. Any rock uncovered in this excavation shall not be left in the backfill. All excess rock shall be removed from the site by this Contractor and legally disposed of off the property. All trenches shall be backfilled and compacted to insure no settling of the surface, after the lawn is planted.

B. If backfill soil is rocky or lumpy, protect the pipe and the pipe conduit with 8” of sand or loose, rock free, soil under, over and on sides of pipe. Avoid putting large rocks against pipe during backfilling operation.

C. All trenches must be compacted to 90% in 6” lifts and watered in. Lines from control valves shall be installed after topsoil is in place and properly graded.

D. This Contractor, in placing the sprinkling lines, etc., may uncover material not suitable for finished grading. This material shall be removed from the site by this Contractor. After the installation of the lines, the finished grading shall be smoothed over and restored to its original condition, using additional topsoil at this Contractor's expense, if this is necessary. The upper 6” of topsoil removed in the excavation of trenches for pipeline shall be conserved and kept separate from subsoil and reinstalled without mixing with other soil.

E. Trenches where more than one pipe is to be installed, a distance of 6” is to be maintained between each pipe.

F. All trenches are to be 12” away from all curbs, buildings and sidewalks. <u>No exceptions</u>.

3.8 PIPING INSTALLATION

A. Install underground polyvinyl chloride (PVC) plastic pipe according to ASTM D 2774.

B. Lay piping on solid sub-base, uniformly sloped without humps or depressions.

1. Slope circuit piping down toward drain valve minimum of ½-inch in 10-feet (1:240).
2. Install polyvinyl chloride (PVC) plastic pipe in dry weather when temperature is above 40 deg. F (4 deg. C). Allow joints to cure at least 24-hours at temperature above 40 deg. F (4 deg. C) before testing, unless otherwise recommended by manufacturer.

C. Minimum Cover: Provide following minimum cover over top of buried piping:
1. Circuit Piping: 24-inches.

D. Install piping under sidewalks and paving in sleeves.

3.9 FLEXIBLE TUBING AND POINT SOURCE EMITTER INSTALLATION

A. Install all flexible risers and point source emitters as per the manufacturers’ specific recommendations.

B. Install the quantity of emitters as per the drawings to correctly irrigate each size of plant at its mature size and water requirements.

C. Thoroughly flush all water lines before installing valves and other hydrants.

D. Test in accordance with Manufacturers recommendations.

3.10 DRIP LINE INSTALLATION

E. Install all dripline as indicated on drawings. Use only Teflon tape on all threaded connections.

F. Clamp Techline/Techlite fittings with Oetiker clamps when operating pressure exceeds specific drippline fitting requirements.

G. When installing Techline/Techlite drippline on-surface, install soil staples as listed below:

3. Sand Soil:- One staple every three (3') feet and two (2) staples on each change of direction (tee, elbow, or cross).

4. Loam Soil:- One staple every four (4') and two (2') staples on each change of direction (tee, elbow or cross).

5. Clay Soil:- One staple every five (5') feet and two (2') staples on each change of direction(tee, elbow or cross).

H. Cap or plug all openings as soon as lines have been installed to prevent the entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.

I. Install two 12" pop up heads per each drip line valve. Pop up heads shall be used to notify and indicate operation of drip system.

J. Thoroughly flush all water lines before installing valves and other hydrants.

K. Test in accordance with Manufacturers recommendations.

3.11 VALVE INSTALLATION

A. Valves: Install underground valves in valve boxes or pits.

1. Install valves and polyvinyl chloride (PVC) pipe with restrained, gasketed joints.

B. Curb Stops: Install underground curb stops in service boxes.

C. Control and Ball Valves: Install in valve control valve boxes, arranged for easy adjustment and removal. Install unions with one (1) on upstream side at each valve manifold.

3.12 SPRINKLER INSTALLATION

A. Sprinklers: Flush circuit piping with full head of water and install sprinklers after hydrostatic test is complete.

1. Install lawn sprinklers at manufacturer's recommended heights.
2. Install shrubbery sprinklers at heights indicated.
3. Locate part-circle sprinklers to maintain a minimum distance of 12-inches (400 mm) from walls and 2-inches (50 mm) from other boundaries, unless otherwise indicated.

3.13 DRAINS:

A. All lines shall be sloped to drain. A minimum of drains should be used. Extra drain valves necessitated by unforeseen field conditions to make the system drain shall be provided by the Contractor and approved by the Landscape Architect.

B. A suitable gravel sump shall be provided for each drain, minimum of 6" below the finished grade. A sump shall be a 24" diameter hole filled with gravel 2" above and 22" below the drain.

3.14 DRIP FILTERS:

A. Filters shall be installed immediately after the electric valve and before the pressure regulator. An appropriate valve box shall be used to insure easy access to the filter for cleaning purpose.

3.15 DRIP SYSTEM PRESSURE REGULATORS:

A. The regulators shall be installed after the filters and must not be buried, but shall be accessible for inspections and maintenance.

3.16 MANUAL FLUSH VALVES:

A. These valves serve to provide flushing during installation and in case of major breaks or contaminations in the system. They shall be installed one for every auto line flush valve, at grade and directly adjacent to the auto flush valves but not in a box

3.17 FIELD QUALITY CONTROL

A. Testing: Perform hydrostatic test of piping and valves before backfilling trenches. Piping may be tested in sections to expedite work.

1. Cap and subject the piping system to a static water pressure of 50 psig (345 kPa) above the operating pressure, but not less than 150 psig without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4-hours. Leaks and loss in test pressure constitute defects that must be repaired.
2. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
3. Notify Architect 24 hour in advance of pressure testing so test may be observed.

3.18 CLEANING AND ADJUSTING

A. Flush dirt and debris from piping before installing sprinklers and other devices.

B. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.

3.19 COMMISSIONING

A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturers, proceed as follows:

1. Verify that specialty vales and their accessories have been installed correctly and operate correctly.
2. Verify that specified test of piping are complete.
3. Check that sprinklers and devices are correct type.
4. Check that damaged drip tube, emitters and devices have been replaced with new materials.
5. Energize circuits to electrical equipment and devices.
6. Adjust operating controls.

B. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinklers are adjusted to final position.

3.20 DEMONSTRATION

A. Demonstrate to Architect that system meets coverage requirements and that automatic controls function properly.

B. Demonstrate to Owner's maintenance personnel operation of equipment, sprinklers, specialties, and accessories. Review operating and maintenance information.

C. Provide 7-days' written notice in advance of demonstration.

END OF SECTION 328402

SECTION 329200 - LAWNS AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Seeding.
2. Sodding.

B. Related Sections include the following:

1. Division 31 Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
2. Division 31 Section 312000 "Earthwork" for excavation, filling and backfilling, and rough grading.
3. Division 32 Section 329300 “Landscape Planting” for general landscape requirements.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. Planting Soil: Topsoil mixed with soil amendments. See 329300

D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turf grass sod, seed and plugs, identifying source, including name and telephone number of supplier.

C. Product Certificates: For soil amendments and fertilizers, signed by product manufacturer.

D. Qualification Data: For landscape Installer.

E. Planting Schedule: Indicating anticipated planting dates for each type of planting.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns and turf areas during a calendar year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn and turf area establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding."

1.7 SCHEDULING

A. Seeding operations of the fire lane area is to be completed prior to April 15, 2011.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. No lawn seeding after Sept. 15

2. Dormant native seed to be installed at the appropriate time as approved by WSU.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.8 LAWN MAINTENANCE

A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established:

B. Guarantee a good stand of grass by watering, mowing, re-grading, re-seeding, re-plugging and re-sodding eroded areas and otherwise maintaining lawn area to the satisfaction of the Landscape Architect, until final acceptance. Any areas, which fail to show a thick, vigorous, healthy grass stand, shall be sodded, re-plugged or re-seeded at Contractor's expense with the same seed or sod originally specified. Re-sod, re-seed or re-plug, as required until all affected areas are accepted by the Landscape Architect

C. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.

D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow grass 2 to 3 inches (50 to 75 mm) high.

E. Lawn Post fertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to lawn area.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Sod: Certified Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with TPI's "Specifications for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Sod shall be cultivated sod, free of weeds and undesirable grasses, machine cut to supplier's standard width and length and 5/8" thick. Measurement for thickness shall exclude top growth and thatch. Blend of grasses shall contain Kentucky Bluegrass and Perennial Ryegrass and shall be of good texture, free from noxious roots, stones and foreign materials. The sod shall be

nursery grown, and shall be well rooted one (1) year old growth of permanent and desirable grasses, suitable for growth in the general location of the project.

1. Sod shall be composed of the following grass varieties in the proportions stated:

Grass Type and Variety	Percent by Weight	Purity	Germination
Perennial Ryegrass “Brightstar II”	10	98	85-90
Perennial Ryegrass “Majesty”	10	98	85-90
Kentucky Bluegrass “Goldrush”	16	98	85-90
Kentucky Bluegrass “Baron”	16	98	85-90
Kentucky Bluegrass “KenBlue”	16	98	85-90
Kentucky Bluegrass “Limosine”	16	98	85-90
Kentucky Bluegrass “Midnight”	16	98	85-90

C. The surface on which lawn is to be installed shall be firm and free of footprints, depressions or undulations of any kind. The surface shall be free of all rocks larger than 1/2” in diameter and all sticks, roots, rubbish, and other extraneous materials.

D. If a crust has formed on the topsoil, it shall be loosened by raking prior to seeding.

2.2 TURFGRASS SEED

A. Seed shall be cultivated sod, free of weeds and undesirable grasses, machine cut to supplier’s standard width and length and 5/8” thick. Measurement for thickness shall exclude top growth and thatch. Blend of grasses shall contain Kentucky Bluegrass and Perennial Ryegrass and shall be of good texture, free from noxious roots, stones and foreign materials. The sod shall be nursery grown, and shall be well rooted one (1) year old growth of permanent and desirable grasses, suitable for growth in the general location of the project.

1. Seed shall be composed of the following grass varieties in the proportions stated:

Grass Type and Variety	Percent by Weight	Purity	Germination
Perennial Ryegrass “Brightstar II”	10	98	85-90
Perennial Ryegrass “Majesty”	10	98	85-90
Kentucky Bluegrass “Goldrush”	16	98	85-90
Kentucky Bluegrass “Baron”	16	98	85-90
Kentucky Bluegrass “KenBlue”	16	98	85-90
Kentucky Bluegrass “Limosine”	16	98	85-90
Kentucky Bluegrass “Midnight”	16	98	85-90

2.3 NATIVE SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: State-certified seed of grass species, as follows:

C. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:

1. Seed Mix shall be composed of the following grass varieties in the proportions stated:

SPECIES	PLS lbs/acre
Indian ricegrass (Achnatherum hymenoides)	6.20
Western wheatgrass (Pascopyrum smithii)	7.70
Tufted hairgrass (Deschampsia cespitosa)	0.30
Galleta grass (Pleuraphis jamesii)	4.00
Blue grama (Bouteloua gracilis)	1.00
Nodding brome (Bromus anomalus)	0.40
Canada bluegrass (Poa compressa)	0.40
TOTAL:	**20.00**

The seeding rate is 24 pounds per acre.

2.4 INORGANIC SOIL AMENDMENTS

A. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 (3.35-mm) sieve and a maximum 10 percent passing through No. 40 (0.425-mm) sieve.

B. Perlite: Horticultural perlite, soil amendment grade.

C. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.

D. Sand: Clean, washed, natural or manufactured, free of toxic materials.

2.5 ORGANIC SOIL AMENDMENTS

A. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.

2.6 PLANTING ACCESSORIES

A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

2.7 COMMERCIAL FERTILIZER - LAWN

A. Fertilizer for trees, shrubs and ground cover planting areas shall be slow release type, Osmocote 18-6-12 used according to manufacturer's printed instructions.

2.8 MULCHES

A. Clean, mildew and seed-free, salt hay or threshed straw.

B. Peat Mulch: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding overspray.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LAWN PREPARATION

A. Limit lawn subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches (100 mm) Remove stones in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply fertilizer directly to subgrade before loosening.
2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend.

   a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.

3. Spread planting soil as specified in Section 02900 – Landscaping.

C. Unchanged Subgrades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least of 6 inches (150 mm). Apply fertilizers according to topsoil report. Till soil to a homogeneous mixture of fine texture.

3. Remove stones larger than 1/2 inch (12 mm) in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.

E. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.4 SODDING

A. Place sod in locations shown only after fine grading has been completed. The top soil and sub-base shall be moist enough to resist shifting and have one (1) application of commercial fertilizer 4-4-3 at the rate of 6 lbs. per 1,000 sq. ft. just prior to the laying of the sod.

B. Sod may be placed at any time when the ground is not frozen. Sod shall be cut and laid on site within a 48 hour period following harvest. The surface on which the sod is to be laid should be firm and free from footprints or other depressions. A string or line of boards may be used as a guide for setting the first line of sod across the area. Sod of the next course is matched against the edge of this first line in such a way the joints between the individual sod pieces in the two lines do not coincide. Successive courses are matched against the last line laid, in the same manner.

C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.

D. The joints shall be closely laid and filled with a mixture of grass seed and screened topsoil at the rate of two (2) pounds of seed to each cubic yard of topsoil. It shall be thoroughly tamped to a true and even surface at the required finished grade.

E. Slopes greater than 1:3 should be staked down by driving a wooden peg through the sod. Always lay sod across slope. Wire stakes shall not be used for pegging sod.

F. Roll firmly but lightly, tamp with suitable wooden or metal tamper, all new sod sufficiently to set or press sod into underlying soil.

G. Upon completion of sodding and filling voids with soil, the sod is to be completely saturated with water. Watering of the sod shall be the complete responsibility of the Contractor by whatever means necessary to establish a vigorous growing lawn.

H. The grass shall be mowed before it exceeds three (3”) in height. The grass will be cut to not less than 1” and during the establishment and maintenance period the lawn shall not exceed two (2”) in height. Lawn clippings that remain on the lawn surface longer than 4 days shall be removed and disposed of properly.

I. Protection of the newly laid sod shall be the complete responsibility of the Contractor. Provide acceptable visual barriers by means of barricades set at appropriate distances and strings or tapes between the barriers as an indication of new work. Restore any damaged areas caused by others, erosion or vehicular traffic until such a time as the lawn is accepted by the Owner

J. Saturate sod with fine water spray within two hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.5 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at the rate of 24 lb/acre

C. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into topsoil with suitable mechanical equipment.
2. Bond straw mulch by spraying with asphalt emulsion at the rate of 10 to 13 gal. /1000 sq. ft. (38 to 49 L/92.9 sq. m). Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

F. Protect seeded areas from hot, dry weather or drying winds by applying peat mulch within 24 hours after completing seeding operations. Soak and scatter uniformly to a depth of 3/16 inch (4.8 mm) and roll to a smooth surface.

3.6 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with tackifier. Tackifier rate to be 120 lbs per acre.
2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 2000-lb/acre (15.3-kg/92.9 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate.

B. No seeding shall be done when wind velocities exceed 4 mph or 8 mph for hydroseeding.

3.7 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

C. Remove erosion-control measures after grass establishment period.

3.6 MAINTENANCE

A. As part of this Contract, this Contractor shall be responsible for the continuous maintenance of all landscape areas, i.e., weeding, watering, mowing, fertilization, etc. from the time that each section of lawn is required to be planted until the Project Date of Substantial Completion. See Section 011000 Summary of Work. If any lawn area is deemed not to be substantially complete by the Project Date of Substantial Completion, penalties will apply and the contractor shall be required to provide all required maintenance after the project substantial completion date until final acceptance.

B. Lawns shall be maintained for as much time as necessary to establish over the entire lawn a close stand of grass of the varieties specified, free of weeds and undesirable coarse, native grasses.

C. All lawns shall be fertilized every three (3) weeks with three (3) pounds of 4-4-3 commercial fertilizer per 1000 sq ft until the end of the maintenance period required. It shall be the responsibility of this Contractor to notify the Landscape Architect and Owner in writing 48 hours prior to fertilizing to provide visual verification of work.

D. Maintenance shall include, in addition to the above, cleaning, edging and repair to erosion and all other necessary work of maintenance. Sidewalks and other paved areas shall be kept clean when planting and maintenance are in progress.

E. Any and all sprinkler lines broken or disrupted during the construction and maintenance period shall be replaced to proper working order and be acceptable to the Owner.

END OF SECTION 329200

SECTION 329300 – LANDSCAPE PLANTING

PART 1 – GENERAL

1.1 SUMMARY

A. The extent of the landscaping development work is shown on the drawings and in schedules. This work includes:

1. Obtaining and paying for permit fees, inspections and tests required for the installation of landscape planting.
2. Providing and placement of all plant material, topsoil, mulch, sod, seed, miscellaneous materials and maintenance of landscape planting and associated guarantees.
3. Repair the existing Landscape Planting as required to restore to “as-new” condition.
4. Attendance at Pre-Construction Conference

1.2 RELATED WORK

A. Division 1 – Section 011000 – SUMMARY

B. Division 2 – Section 328400 - Irrigation Systems

1.3 QUALITY ASSURANCE

A. Plants shall conform to names indicated on the drawings and plant list and to the nomenclature listed in the American Joint Committee on Horticultural Nomenclature’s “Standardized Plant Names”, latest edition.

B. Size, quality, handling, planting and maintenance of plant materials shall be in accordance with “American Standard for Nursery Stock”, ANSI Z60-1996, American Association of Nurserymen, Inc. Minimum acceptable sizes of plants, measured before pruning with branches in normal position, shall conform to measurements specified in the Plant Materials Key.

C. Plants shall be subject to the Landscape Architect’s inspection and approval at place of growth or upon delivery for conformity to specification requirements. Such approval shall neither preclude right of rejection upon delivery at the site or during progress of work, nor right of rejection at the site due to damage suffered in handling or transportation. Inspection of plants by the Landscape Architect before digging shall be at the option and expense of the Owner.

1. All plant material will be inspected again at time of final inspection and once again at the end of the warranty period.
2. Any plant material found to be unacceptable at any inspection shall be immediately removed and replaced.

D. Contractor will provide and pay for materials testing. Testing agency shall be acceptable to the Landscape Architect.

1. Test representative samples of materials proposed for use. Materials used in the work shall be the same materials as tested. Do not use proposed material in the work until test reports

have been reviewed by the Landscape Architect and approval obtained to proceed with plant excavations.

E. Test reports: Provide the following information:

1. Topsoil:
   a. Mechanical analysis.
   b. Percentage of organic content.
   c. Recommendations on the type and quantity of soil nutrient additives required to bring nutrients to a satisfactory level for specified plants.
   d. Recommendations on the type and quantity of soil additives required to bring the pH of soil to a value of 5.5-7.0 (unless otherwise noted).
   e. SAR
   f. Soluble Salts

2. If on-site topsoil is used, provide a minimum of 4 separate tests to verify mechanical analysis, organic matter content, and nutrient level and pH value of topsoil. Sample locations as directed by the Landscape Architect.

F. Landscape work shall be done by a single firm specializing in landscape construction work with minimum 5 years experience completing projects of similar size and complexity.

1. Contractor to provide list of past projects completed during last 3 years at time of first bid proposal.

2. All landscape work shall meet the construction and post construction monitoring of the DFCM landscape guidelines. This contractor shall be required to complete all forms required to satisfy DFCM requirements.

1.4 SUBMITTALS

A. General: Submit each item in this article and for each item listed in Part 2 – Materials for review and approval according to the General Conditions of the Contract and Specifications - Division 1.

B. Submit Certificate of Inspection of plant material by state or federal authorities.

C. Submit commercial soils test with material test reports and soil nutrient additive recommendations.

D. Submit a label from the manufacturer's container certifying fertilizer content.

E. Submit samples of proposed mulch for use in planting beds.

F. Submit complete written maintenance instruction at least 10 days prior to end of maintenance period. Include all requirements for proper care, development and maintenance of planting.

G. Submit within 20 days of award of the bid to general contractor a planting schedule stating sources from which said Contractor can provide the plant materials in the quantity and size indicated on the Drawings.

1. Substitutions for plant material that is not obtainable may be proposed in writing prior to bid. Submit written statement from plant materials supplier(s) with proposal for equivalent material for evaluation and acceptance prior to bid.

H. Submit photographs and other descriptions of all plant material that is located outside of a 90 mile radius of project location. Provide specific growing location address.

I. Submit contractor's Guarantee Form for Landscape Architect's review.

J. Submit seed analysis certification.

1.5 VERIFICATION OF DIMENSIONS AND QUANTITIES

A. All scaled dimensions are approximate. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions and quantities, and shall immediately inform the Landscape Architect of any discrepancy between the information on the Drawings and actual conditions, refraining from doing any work on said areas until given approval to do so by the Landscape Architect.

B. Plant quantities listed on the Drawings are for the convenience of the Contractor only and are not guaranteed. All planting indicated on the Drawings will be required unless indicted otherwise.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Prepare, transport and handle plants to ensure protection against injury. Cover all plants while transporting to the site.

B. Deliver plants with legible waterproof identification labels.

C. Temporary storage of new material:

1. No new plants shall remain in temporary storage over the winter or summer. Plants that are not planted immediately shall be protected as follows:

   a. Plants shall remain on the site of the work no longer than three days prior to being planted or placed in storage.
   b. The earth balls shall be kept moist and their solidity carefully preserved. To prevent drying out or freezing, store plants in a compact group with suitable mulch material placed around and between the balls so they are completely covered. The method of storage of plants and mulch material shall be acceptable to the Landscape Architect.
   c. Provide irrigation to stored plants.

D. Do not deliver or use topsoil in frozen or muddy conditions.

E. Packaged materials shall be delivered in factory labeled containers showing weight, content and manufacturer. Protect all materials from damage and deterioration during delivery and storage at site.

1.7 GRADING

A. Examine the subgrade, verify the elevations of topsoil, planting mix or mulch. Observe the conditions under which work is to be performed, and notify the Landscape Architect of unsatisfactory conditions. Do not begin landscape work until unsatisfactory conditions have been improved.

1.8 EXCAVATION

A. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Landscape Architect before planting.

1.9 EXISTING UTILITIES

A. Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required, to minimize possibility of damage to underground utilities. The Contractor shall have the area “Blue Staked” prior to digging. It is the responsibility of the Contractor to repair or replace any damage caused by its workers at no expense to the Owner.

1.10 PLANTING SCHEDULE

A. Before bidding each bidder shall investigate sources of supply and determine availability of all plants specified on the planting list in size, variety and quantity. Failure to take this precaution will not relieve the successful bidder from responsibility as a contractor to furnish and install all plant material in strict accordance with the contract without additional expense to the Owner.

B. Prepare a proposed planting schedule for approval by the Landscape Architect. Schedule the dates for each type of landscape work during the normal seasons for such work in the area of the site. Correlate with specified maintenance periods to provide maintenance throughout the specified time period. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

C. Proceed with and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required.

1.11 ESTABLISHMENT, MAINTENANCE, REPLACEMENT, AND GUARANTEE

A. The establishment period shall begin at the time that the planting phase of the work is completed, inspection and written notice is given and shall continue until substantial line. See Total Site Maintenance section 3.10.

B. Maintenance shall include but not be limited to watering, weeding, pruning, spraying, adjusting of guys, and lawn maintenance as described herein.

C. Remove and replace trees found to be unacceptable at the time of substantial completion and at any time during the guarantee period. Replacements shall be made during the guarantee period. Replacements shall be made during the growing season and shall comply with all requirements and specifications. Replacement shall also match specified trees in specie, size, and condition. Any delaying the completion of any item of work in the planting operation which extends the planting into more than one season shall extend the guarantee period accordingly.

D. Any plants that settle below or rise above the desired finished grades during establishment or guarantee period shall be reset at the proper grades.

E. Guarantee a close knit stand of grass by watering, mowing, regrading and resodding eroded areas and otherwise maintaining lawn area to the satisfaction of the Landscape Architect, until final acceptance. Any areas, which fail to show a thick, vigorous, healthy grass stand, shall be reseeded at Contractor's expense with the same seed or sod originally specified. Resod or reseed as required until all affected areas are accepted by the Landscape Architect.

F. Guarantee all planting for one year following signature of Owner on the final contract payment application.

G. The Contractor will not be responsible for plants destroyed or lost due to occupancy of the project, or vandalism on the parts of others or if the failure of any plant material can be proven to the Landscape Architect to be beyond the control of the Contractor.

H. At the end of the guarantee period a final inspection of all planting included in this contract will be made by the Landscape Architect. At that time any plant found not to be in a healthy growing condition, broken, damaged, or not exhibiting the desired characteristics of the plant shall be noted. These noted plants shall be removed as specified above.

PART 2 – MATERIALS

2.1 TOPSOIL

A. Topsoil for planting operations shall be imported onto the project site. It shall be friable, fertile, natural sandy loam containing a minimum of 2% of humus, or natural surface soil typical for this locality, and shall be capable of sustaining vigorous plant growth. It shall be free of admixture of subsoil and shall be reasonable free of stones, lumps, clods of hard earth, plants or their roots sticks, or other extraneous matter. It shall not be used for planting operations in a frozen or muddy condition.

B. Prior to delivery of topsoil to the site the Contractor shall furnish commercial soil tests for Landscape Architect's approval. If such tests indicate the topsoil to be other than the type specified it shall be replaced with a topsoil which shall conform to the specifications at no additional compensation to the Contractor.

C. Topsoil shall not be used for planting operations while in a frozen or muddy condition.

2.2 PEAT MOSS

A. Peat moss used in planting soil preparation: High quality pure Canadian sphagnum peat with a pH value not less than 3.5 nor greater than 6.0 at 25 degrees C. The ash content shall be not more than 10% and water holding capacity shall be not less than 800%.

2.3 ORGANIC SOIL CONDITIONER

A. Organic soil conditioner shall be composted and nitrogen stabilized Soil-pep by Mt. West Products, Rexburg, Idaho.

2.4 BACKFILL

A. Backfill soil mixture shall be the following materials well mixed in the specified proportions, which are by volume.

Product	Proportion
Peat moss or organic soil conditioner	1 part
Topsoil	4 parts

2.5 COMMERCIAL FERTILIZER – LAWNS

A. Fertilizer for lawns shall be commercial fertilizer, uniform in composition, dry and free flowing. It shall contain the following percentage by weight: 16% of nitrogen, 16% of phosphoric acid, 8% of potash. Fertilizer shall be delivered mixed as specified in standard-sized bags, showing weight, analysis of content, and name of manufacturer as required by state regulations. If soil tests recommend variance from these percentages obtain Landscape Architect's approval prior to applications.

2.6 COMMERCIAL FERTILIZER – TREES AND SHRUBS

A. Fertilizer for trees, shrubs and ground cover planting areas shall be slow release type, Osmocote 18-6-12 used according to manufacturer's printed instructions.

2.7 PLANT MATERIAL

A. All plants are subject to approval regarding size, health, quantity, character, etc. by the Landscape Architect.

B. The Contractor shall furnish and plant all plants shown on the Drawings, as specified and in quantities as shown. Quantities if shown, are included for the convenience of the Contractor only and the Contractor shall be required to furnish all individual plants in quantities actually located on the Drawings. Each bidder shall investigate the sources of supply and satisfy himself that he can supply all of the plants mentioned in the planting lists in size, variety and quality noted and specified before submitting his bid. Failure to take this precaution will not relieve the successful bidder from his responsibility as Contractor for the furnishing and installing of all the plant material in strict accordance with the contract requirements without additional expense to the Owner.

C. All plants shall have been grown in nurseries which have been inspected or do not require inspection by the State Department of Agriculture and have complied with all the regulations thereof, in accordance with good horticulture practice.

D. Plant names used in the Plant Material Key conform to "Standardized Plant Names" by the American Joint Committee of Horticulture Nomenclature, except in cases not covered therein. In these instances, the custom of the nursery trade is followed.

E. Plant materials shall conform to the Plant Material Key shown on plans and to the requirements of the "Horticultural Standards" of the American Association of Nurserymen as to kind, size, age, etc. and shall be typical first-class representatives of their species or variety, and shall have a

normal habit of growth, unless specified otherwise. They shall be sound, healthy and vigorous with a well-developed root system.

F. All plants shall have been grown under climatic condition similar to those in the locality of the project for at least two (2) years and shall have been transplanted or root pruned at least once in the last two (2) years.

G. All plants shall be number one quantity specimens and shall have a uniform matching caliper, size and canopy, be symmetrical with standard height, spread and branching patterns. No park grade plant material is acceptable.

1. Trees shall have straight single leaders with symmetrical primary branching and considerable well spaced secondary branching filling out the head with no gaps.

H. Plants shall be marked for identification. Each bundle of plants and at least 25% of each species and variety of separate plants in any one (1) shipment shall have legible labels securely attached before delivery to the site.

I. All trees shall be measured when their branches are in their normal position. Height and spread dimensions specified refer to the main body of the plant and not from branch or root tip to tip. No trees which have had their leaders cut, or so damaged that cutting is necessary, will be accepted. Measure caliper of all trees 4” and larger 12” above the surface of the ground. Measure all trees less than 4” in caliper 6” above finish grade.

J. All plants shall be symmetrical and shall conform to the size, age and condition as specified on the plant list shown on the Drawings. Exceptions are as follows:

1. Plants larger than specified in the plant list may be used if approved by the Architect; but use of such plant shall not increase the contract price. If the use of larger plants is approved, the spread of roots and ball earth shall be increased in proportion to the size of the plant. Bare root plants furnished in size greater than specified shall be balled and burlapped when required by the Landscape Architect.
2. Where caliper or other dimensions of any plant materials are omitted from the Plant Material Key, it shall be understood that these plant materials shall be normal stock for type listed and at a minimum, the average size of all the material listed.

K. Plants shall not be pruned prior to delivery except as authorized by the Landscape Architect. In no case shall trees be topped before delivery.

L. No plants shall be dug or delivered to the site until the required inspections have been made and the plants or samples approved.

M. Dig balled and burlapped (BB) plants with firm, natural balls of earth, of diameter not less than specified and of sufficient depth to include all fibrous and feeding roots. No plant moved with a ball will be accepted if the ball is cracked or broken before or during planting operations, except on special approval of the Architect.

N. Roots or balls or all plants shall be adequately protected at all times from sun and/or drying winds.

1. All balled and burlapped plants which cannot be planted immediately upon delivery shall be set on the ground and shall be well protected with soil, wet moss, or other acceptable material.
2. Bare rooted plants, which cannot be planted immediately, shall be planted or heeled-in in trenches immediately upon delivery. No materials heeled-in more than one week may be used. Bundles of plants shall be opened and the plants separated before the roots are covered. Care shall be taken to prevent air pockets among the roots. During planting operations, bare roots shall be covered with canvas, wet straw or other suitable materials.
3. No plant shall be bound with wire or rope at any time so as to damage the bark or break branches.

O. Plants marked “cans”, “pots” or “other container” on the plant list shall have been grown in the containers for a minimum of six (6) months and a maximum of two years. Roots shall fill the containers but show no evidence of being or having been root bound. Plants shall not be picked up or moved by stem or branches, but shall be lifted and handled from the sides of the containers.

P. Trees shall have straight trunks and all old abrasions and cuts shall be completely callused over.

2.8 GUYING AND STAKING MATERIAL

A. Tree stakes: steel “T” post, 8’long.

B. Hose: High quality braided rubber or plastic hose, ¾” diameter and suitable length (Color Black).

C. Wire: 12 gauge galvanized steel.

D. Guying cable: galvanized steel, #9 gauge, imbles and clips shall be used for connections and splices.

E. Turnbuckles: Galvanized or zinc dip painted with an 8” lengthwise opening fitted with eye bolts and spot welded or fitted with a locking device to prevent vandalism.

F. Guying stakes: 2” x 2” x 8’ notched hardwood.

G. Duckbill tree support system by Foresight Industries (800-325-5360) shall be used for trees larger than 3” caliper.

2.9 MULCH

A. Mulch shall be coarse shredded bark or wood product, nitrogen stabilized. Mulch must be 100% bio-degradable.

2.10 WEED BARRIER FABRIC

A. Fabric shall be UV resistant, woven spunbond needle punch, polyproplene, wt. 5 oz, per square yard, color black. Use Dewitt Pro 5 Weed Barrier.

2.11 ANTI-TRANSPIRANT

A. Anti-TRANSPIRANT solution for horticultural spray application. Use Bio-Plex, by Bioplex Organics, Inc. (800-441-3573).

2.12 WATER

A. Potable water

2.13 TREE WRAP

A. Tree wrap shall be kraft paper tree wrap, 3" wide or TREESAVER brand perforated tree wrap as manufactured by Mountain Valley Seed, Inc. 1800 South West Temple, Salt Lake City, Utah, 84115, telephone (801) 486-0480. Wrap shall be resistant to weather degradation and require no maintenance and must stretch as the girth of the truck increases over time.

PART 3 – EXECUTION

3.1 COORDINATION

A. The contractor shall coordinate his work with other contractors on site, and shall cooperate to the fullest extent to see that the work is completed in a timely and workmanship like manner.

3.2 INSTALLATION OF TOPSOIL

A. Prior to the installation of any topsoil, Contractor shall inspect the existing subgrade for compliance to the specifications regarding elevation, slope, grade and cleanliness. Any deficiency shall be reported to the Landscape Architect. Work begun in any area will acknowledge acceptance of area for Landscape planting.

B. When contract operations have been completed to a point where planting areas will not be disturbed, subgrade shall be cleaned free of waste material of all kinds. In all planted areas dig out all to weeds by their roots and remove from site. Scarify and pulverize the subgrade to a depth of not less than 6" inches. Scarification shall be completed in all areas that are to be planted, or sodded.

C. Spread the topsoil to a minimum depth of 12" in planting beds and ground cover areas allowing for 3" of bark mulch. Till to a depth of 6".

D. Spread the topsoil and till to a minimum depth of 6" in all lawn areas. Do not place topsoil over subgrade that is frozen or damp. Place topsoil just prior to seeding so as to discourage weed growth.

E. Topsoil shall be rolled by a hand roller on small areas. After rolling at a weight of 150-200 pounds per linear foot of roller, the grade shall again be graded to the specified grade with a smooth surface. Large areas shall be graded by passing a land plane in three different directions over the entire area to be planted.

F. Surface drainage shall be insured, and if shown, shall be directed in the manner indicated on the Drawings by molding the surface to facilitate the run-off water. Fill low spots and pockets with topsoil and grade to drain properly.

G. The finish grade of the topsoil adjacent to all sidewalks, mow strips, etc., and prior to planting shall be 1 ½" below the top surface of adjacent pavement or hard surface of any kind.

H. The Landscape Architect shall approve the finish grading prior to application of seed, sod or plant material. Make minor adjustments to finish grades at the direction of the Landscape Architect.

3.3 PREPARATION FOR PLANTING TREES AND SHRUBS

A. All sprinkler system work and finish grading shall be approved by the Landscape Architect prior to any planting. No planting will be done without direct supervision of the Landscape Architect. Tree planting shall precede lawn planting.

B. Locate the exact placement of all trees and secure approval of the Landscape Architect and Owner prior to the digging of any holes. Refer to the Drawings for the sizes and preparation of holes. Prepare all holes according to the details on the Drawings.

3.4 PREPARATION OF LAWN AREAS

A. The surface on which lawn is to be installed shall be firm and free of footprints, depressions or undulations of any kind. The surface shall be free of all rocks larger than 1/2" in diameter and all sticks, roots, rubbish, and other extraneous materials.

B. If a crust has formed on the topsoil, it shall be loosened by raking prior to seeding.

3.5 TREE AND SHRUB PLANTING

A. Prior to planting, fill excavated planting hole with water and allow to percolate out. If, after 24 hours, the water has not percolated out of the pit, notify the Landscape Architect. Do not plant until the problem has been corrected.

B. The planting holes from the bottom to the top of the opening should be the same depth as the root ball. Plants must be placed plumb and straight in the planting hole. The tree planting hole depth shall be determined so that the tree may be set at finish grade, using the top of the root ball as a guide.

C. All tree holes shall be backfilled with specified backfill in 12" inch lifts and settled and tamped to minimize any settling of the tree.

D. When the root ball is partially backfilled and compacted all burlap, ropes, or wire baskets shall be removed from the sides of the root ball. No burlap shall be pulled from under the root balls of the plants. The plants shall then be watered with a hose to completely soak the roots and the backfilled soil mixture.

E. Fertilize with tree and shrub fertilizer according to manufacturer's printed instructions.

F. Containers shall be removed from the root balls by cutting with cutters. Do not damage root ball by using trunk or main stem as a handle.

G. All plants shall be thoroughly watered immediately following planting. This shall mean full and thorough saturation of all backfill in the pits and beds during the same day of planting. Water shall only be applied by an open end hose at very low pressure to avoid air pockets, injury or washing. When planted, watered, and fully settled, trees shall be vertical.

H. The Contractor shall hand water newly planted trees twice a week for eight weeks. A minimum of five (5) gallons of water per tree is required.

I. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches. All cuts, scars and bruises shall be properly treated according to the direction of the Landscape Architect. Proper pruning techniques shall be used. Do NOT leave stubs and do NOT cut the leader branch. Improper pruning shall be cause for rejection of the plant material.

J. A 3” deep saucer shall be formed at the edge of plant pit. Water the same day as planted.

K. Saucer shall not be required when planted where edging is required around plant pits. When trees are planted in lawn areas cut a neat opening in sod that is 36” diameter.

L. Within 48 hours of planting each plant remove all undesirable material from the surface of the planting beds, including all rocks over the size of 1 ½” diameter. Install the specified mulch to a uniform depth of 3” in the entire planting beds and all tree basins.

M. This Contractor shall dispose of, off the site, all soil excavated from tree and shrub pits.

3.6 PLANTING GROUND COVERS

A. Space plants as shown or scheduled.

B. Dig holes large enough to allow for spreading of roots and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.

C. Fertilize entire bed with slow release shrub fertilizer at rate recommended in manufacturer’s printed instructions.

3.7 TREE STAKING AND GUYING

A. Staking of trees shall be done immediately after they are planted. Plants shall stand plumb after staking. All stakes shall be removed by this Contractor after the guarantee period has concluded.

B. Trees 2 ½” caliper or less shall be supported by two steel “T” stakes placed diametrically opposite at perimeter line of ball and to sufficient depth to hold tree rigid. Stakes shall be driven vertically and not twisted or pulled. Tree shall be wired to each stake as indicated on staking details. Project tree with rubber hose over wires at points of contact.

3.8 TREE WRAPPING

A. All trees shall be wrapped with tree wrap. Wrap shall be applied to trunks immediately after planting to protect bark against winter injury caused by diurnal temperature fluctuations. Wrap shall be resistant to weather degradation and require no maintenance and must stretch as the girth of the trunk increases over time.

1. Starting as low as possible, wrap tree wrap in a smooth spiral to assure overlapping each previous wrap by about ¼".
2. Continue wrapping up the trunk to just below the second scaffold branches. Wrapping the crotches is optional.
3. Tie off tree wrap with a half hitch knot.
4. Cover the base of the tree and the first wrap of tree wrap with soil.

3.9 CLEAN UP AND PROTECTION

A. During landscape work store materials and equipment where directed. Keep pavement clean and work area in an orderly condition.

B. Protect landscape areas, work and materials from damage due to operations by other contractors and trades, trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.

C. Keep the site free from accumulation of waste material. At the time of completion, all areas must be swept and washed clean and all rubbish removed to the satisfaction of the Landscape Architect.

D. Temporary occupancy of the project shall not relieve the contractor of any of the obligations enumerated in the Contract Documents.

3.10 TOTAL SITE MAINTENANCE

A. As part of this Contract, this Contractor shall be responsible for the continuous maintenance of all landscape areas, i.e., weeding, watering, mowing, fertilization, etc. from the time that each section of lawn is required to be planted until the Project Date of Substantial Completion. See Section 011000 Summary of Work. If any lawn area is deemed not to be substantially complete by the Project Date of Substantial Completion, penalties will apply and the contractor shall be required to provide all required maintenance after the project substantial completion date until final acceptance.

B. Maintain plants in a vigorous, thriving condition by watering, cultivating, weeding, pruning, spraying and other necessary operations. No trees or shrubs will be accepted unless they are healthy and show satisfactory foliage conditions. Plants shall be maintained through the length of the total site maintenance period.

1. All planted areas shall be cultivated at least every two (2) weeks and raked smooth, to present a neat appearance.
2. Spray as required to keep plant materials free of disease and insects.
3. Replace mulch to maintain specified depth.
4. All new tree and shrub plantings shall be hand watered thoroughly at least twice a week during the maintenance period.

C. The Contractor shall instruct the Owner as to the watering requirements and shall monitor such operations at all times. The Contractor shall be held responsible for failure to monitor the watering requirements and shall be held responsible to replace any or all plants that are lost due to improper application of water.

D. Lawns shall be maintained for as much time as necessary to establish over the entire lawn a close stand of grass of the varieties specified, free of weeds and undesirable coarse, native grasses, but in no case less than four growing months or two mowings after substantial completion of landscape and irrigation work.

E. All lawns shall be fertilized every three (3) weeks with six (2) pounds of 16-16-8 commercial fertilizer per 1000 sq ft until the end of the maintenance period required. It shall be the responsibility of this Contractor to notify the Landscape Architect and Owner in writing 48 hours prior to fertilizing to provide visual verification of work.

F. Maintenance shall include, in addition to the above, cleaning, edging and repair to erosion and all other necessary work of maintenance. Sidewalks and other paved areas shall be kept clean when planting and maintenance are in progress.

G. Any and all sprinkler lines broken or disrupted during the construction and maintenance period shall be replaced to proper working order and be acceptable to the Owner.

3.11 FINAL INSPECTION AND ACCEPTANCE

A. Inspection will be made of the entire site periodically and at the conclusion of the maintenance period required.

B. The landscape work may be inspected for acceptance in parts agreeable to the Landscape Architect, provided the work offered for inspection is complete, including maintenance and that the area comprises one unit or area of substantial size.

C. Written notice requesting final inspection shall be submitted to the Landscape Architect at least ten (10) days prior to the anticipated inspection date.

D. Where inspected landscape work does not comply with the requirement, replace rejected work and continue specified maintenance until re-inspected by the Landscape Architect and found to be acceptable. Remove rejected plants and materials promptly from the project site.

E. Final Acceptance: The work under this contract will be accepted upon written approval by the Landscape Architect and the Owner, on the satisfactory completion of all work, including maintenance.

F. All work done under this contract shall be left in good order to the satisfaction of the Owner and the Landscape Architect and the Contractor shall without additional expense, replace any trees, etc. which develop defects or die within one year of the substantial completion.

1. A written guarantee that covers the above provisions shall be signed by the Contractor and delivered to the Landscape Architect upon acceptance of the work.
2. The guarantee shall not be binding upon the Contractor if any failure should be proved to the satisfaction of the Landscape Architect to result from circumstances or negligence of parties over whom the Contractor has no control.

3.12 RECORD DRAWINGS

A. Record Drawings shall be furnished to the Landscape Architect at the time of the substantial completion inspection before a letter documenting Substantial Completion for the landscape planting will be issued. This information shall be provided in AutoCadd fomat and shall be given to the Landscape Architect before the project is accepted. The AutoCadd file shall shall be a copy of the original plans for the project and shall be corrected by the contractor at the Contractor's expense.

APPENDIX A

PROJECT DATA FORM

DFCM Project Number: _____

Project Name: _____

Project Address: _____

_____

Type of Facility (See Chart Below): _____

Type of Facility		Water Allowance (% of allowable water used)
A.	**Office type buildings**	**50%**
B.	**Existing campus/institution**	**70%**
C.	**New campus/institution**	**60%**
D.	**Recreational areas (ball fields etc.)**	**70%**
E.	**State Parks (natural areas)**	**10%**

Landscape Architect:

Name: _____ **Date:** _____

Company: _____ **License No.:** _____

Address: _____

_____

Telephone: _____ **Fax:** _____

Landscape Contractor:

Name: _____ **Date:** _____

Company: _____ **License No.:** _____

Address: _____

_____

Telephone: _____ **Fax:** _____

END OF SECTION 329300

SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping joining materials.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Identification devices.
6. Grout.
7. Flowable fill.
8. Piped utility demolition.
9. Piping system common requirements.
10. Equipment installation common requirements.
11. Painting.
12. Concrete bases.
13. Metal supports and anchorages.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. PVC: Polyvinyl chloride plastic.

D. DI: Ductile Iron pipe

1.4 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Identification devices.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Solvent Cements for Joining Plastic Piping:
1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

F. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings NPS 1-1/2 and Smaller:

1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
2. Aboveground Piping: Specified piping system fitting.

C. AWWA Transition Couplings NPS 2 and Larger:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cascade Waterworks Mfg. Co.
   b. Dresser, Inc.; DMD Div.
   c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
   d. JCM Industries.
   e. Smith-Blair, Inc.
   f. Viking Johnson.

3. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

D. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Spears Manufacturing Co.

3. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.

E. Plastic-to-Metal Transition Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Colonial Engineering, Inc.
   b. NIBCO INC.
   c. Spears Manufacturing Co.

F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cascade Waterworks Mfg. Co.
   b. Fernco, Inc.
   c. Mission Rubber Company.
   d. Plastic Oddities.

G. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.
   d. Hart Industries, International, Inc.
   e. Watts Water Technologies, Inc.
   f. Zurn Plumbing Products Group; Wilkins Div.

3. Description: Factory fabricated, union, NPS 2 and smaller.

   a. Pressure Rating: 200 psig minimum.

C. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.
   d. Watts Water Technologies, Inc.

3. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 and larger.

    a. Pressure Rating: 200 psig) minimum.

D. Dielectric-Flange Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.

3. Description: Nonconducting materials for field assembly of companion flanges, NPS 2-1/2 and larger.

    a. Pressure Rating: 200 psig minimum.
    b. Gasket: Neoprene or phenolic.
    c. Bolt Sleeves: Phenolic or polyethylene.
    d. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Calpico, Inc.
    b. Lochinvar Corporation.

3. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 and smaller.

    a. Pressure Rating: 300 psig at 225 deg F
    b. End Connections: Threaded.

F. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Perfection Corporation.
    b. Precision Plumbing Products, Inc.
    c. Victaulic Company.

3. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.

   a. Pressure Rating: 300 psig at 225 deg F.
   b. End Connections: Threaded or grooved.

2.4 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Division 22 Section "Common Work Results for Plumbing."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.5 IDENTIFICATION DEVICES

A. General: Products specified are for applications referenced in other Division 33 Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

   1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
   2. Location: Accessible and visible.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

   1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.7 FLOWABLE FILL

A. Description: Low-strength-concrete, flowable-slurry mix.

1. Cement: ASTM C 150, Type I, portland.
2. Density: 115- to 145-lb/cu. ft.
3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
4. Aggregates: ASTM C 33, natural sand, fine.
5. Admixture: ASTM C 618, fly-ash mineral.
6. Water: Comply with ASTM C 94/C 94M.
7. Strength: 100 to 200 psig at 28 days.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric unions.
2. NPS 2-1/2 to NPS 12: Dielectric flanges or dielectric flange kits.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric couplings or dielectric nipples or nipples.
2. NPS 2-1/2 to NPS 4 : Dielectric nipples.
3. NPS 2-1/2 to NPS 8: Dielectric nipples or dielectric flange kits.
4. NPS 10 and NPS 12: Dielectric flange kits.

3.3 PIPING INSTALLATION

A. Install piping according to the following requirements and Division 33 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by removable PE sleeves.

K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 33 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings at connections of dissimilar metal pipes.

3.6 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.7 PAINTING

A. Painting of piped utility systems, equipment, and components is specified in Division 09 painting Sections.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
   1. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping. Place direct bury marker 12-18 inches above top of pipe but not less than 12-inches below finish grade.

3.9 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION – 330500

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SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:

1. Special fittings for expansion and deflection.
2. Cleanouts.
3. Drains.
4. Precast concrete manholes, inlet boxes, catch basins.
5. Cast in place inlet boxes and catch basins and manhole bases over existing pipes.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

B. CP: Non-reinforced concrete pipe.

C. RCP: Reinforced concrete pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Special pipe fittings.
2. Drains.
3. Storage.
4. Pipes.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.

2. Catch Basins and Stormwater Inlets. Include plans, elevations, sections, details, and frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames and covers, design calculations, and concrete design-mix report.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

E. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of service. Coordinate interruptions during weekly meetings and at pre-construction meeting.
2. Do not proceed with interruption of service without Architect's, Construction Manager's, and Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include local pre-cast manufacturers but are subject to approval of the engineer and architect.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 DUCTILE-IRON PRESSURE PIPE AND FITTINGS

A. Pipe: AWWA C151, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.5 PVC PIPE AND FITTINGS

A. PVC Pressure Pipe: AWWA C900, Class 150 for gasketed joints and using ASTM F 477, elastomeric seals.

1. Fittings NPS 4 to NPS 8: PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.
2. Fittings NPS 10 and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.

B. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 80 pipe, with plain ends for solvent-cemented joints with ASTM D 2467, Schedule 80, socket-type fittings.

C. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness pipe with ASTM D 3034, SDR 35, socket-type fittings for solvent-cemented joints.

D. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

E. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T 2 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

F. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.6 CONCRETE PIPE AND FITTINGS

A. Nonreinforced-Concrete Sewer Pipe and Fittings: ASTM C 14, Class I, II or III, with bell-and-spigot ends and gasketed joints with ASTM C 443, rubber gaskets.

B. Piping in paragraph below is available in 5 classes and 3 wall thicknesses, and in NPS 12 to NPS 144. Not all classes and wall thicknesses are available. Joints are gasket type. Contractor, at his option, may use non-reinforced pipe for sizes up to 21-inches if structural requirements based on load on pipe are not exceeded for that pipe. If reinforced pipe is selected, choose the pipe class and wall thickness to suit availability and structural requirements based on loads and cover.

C. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, with bell-and-spigot ends and gasketed joints with ASTM C 443, rubber gaskets.

1. Class I, Wall [A] [B].
2. Class II, Wall [A] [B] [C].
3. Class III, Wall [A] [B] [C].
4. Class IV, Wall [A] [B] [C].
5. Class V, Wall [B] [C].

2.7 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. NDS Inc.
f. Plastic Oddities, Inc.

D. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg.

b. Dallas Specialty & Mfg. Co.
c. Mission Rubber Company; a division of MCP Industries, Inc.

E. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

1. Manufacturers:

a. Fernco Inc.
b. Logan Clay Products Company (The).
c. Mission Rubber Company; a division of MCP Industries, Inc.

2.8 PRESSURE-TYPE PIPE COUPLINGS

A. Reducing or transition, metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 150-psig minimum pressure rating and ends of same sizes as piping to be joined.

B. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.

1. Manufacturers:

a. Cascade Waterworks Mfg.
b. Dresser, Inc.; DMD Div.
c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc.
g. Viking Johnson.

2. Center-Sleeve Material: Manufacturer's standard.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Couplings: With split sleeve with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.

1. Manufacturers:

a. Brico Industries.

2. Sleeve Material: Manufacturer's standard.
3. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
4. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
5. Metal Component Finish: Corrosion-resistant coating or material.

2.9 SPECIAL PIPE FITTINGS

A. Ductile-Iron Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include 2 gasketed ball-

joint sections and 1 or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.

1. Manufacturers:

   a. EBAA Iron Sales, Inc.
   b. Romac Industries, Inc.
   c. Star Pipe Products.

B. Ductile-Iron Deflection Fittings: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for up to 15 degrees of deflection.

1. Manufacturers:

   a. EBAA Iron Sales, Inc.

C. Ductile-Iron Expansion Joints: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated.

1. Manufacturers:

   a. Dresser, Inc.; DMD Div.
   b. EBAA Iron Sales, Inc.
   c. JCM Industries.
   d. Smith-Blair, Inc.

2.10 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Manufacturers:

   a. Josam Company.
   b. MIFAB Manufacturing, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Wade Div.; Tyler Pipe.
   e. Watts Industries, Inc.
   f. Watts Industries, Inc.; Enpoco, Inc. Div.
   g. Zurn Industries, Inc.; Zurn Specification Drainage Operation.

2. Top-Loading Classification(s): Light, Medium, Heavy, and Extra-heavy duty depending on location and expected driving load on cleanout.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Place in grey iron housing with clamping device and round, secured, scoriated, gray-iron cover.

1. Manufacturers:

   a. Canplas Inc.
   b. IPS Corporation.
   c. NDS Inc.
   d. Plastic Oddities, Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Zurn Industries, Inc.; Zurn Light Commercial Specialty Plumbing Products.

2.11 DRAINS

A. Gray-Iron Area Drains: ASME A112.21.1M, round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.

1. Manufacturers:

   a. Josam Company.
   b. MIFAB Manufacturing, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Wade Div.; Tyler Pipe.
   e. Watts Industries, Inc.
   f. Watts Industries, Inc.; Enpoco, Inc. Div.
   g. Zurn Industries, Inc.; Zurn Specification Drainage Operation.

2. Top-Loading Classification(s): Medium and heavy duty depending on location and expected driving load.

B. Gray-Iron Trench Drains: ASME A112.21.1M, 6-inch to 12-inch-wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular excluded aluminum secured grate per Weber State Standard. Include units of total length indicated and number of bottom outlets with inside calk or spigot connections, of sizes indicated.

1. Trench Manufacturers:

   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.
   c. Wade Div.; Tyler Pipe.
   d. Watts Industries, Inc.
   e. Watts Industries, Inc.; Enpoco, Inc. Div.
   f. Zurn Industries, Inc.; Zurn Specification Drainage Operation.
   g. Poly Drain, ABT

2. Grate Manufacturers

   a. Grating Systems, Inc. (Ogden, Utah).
   b. Ohio Gratings, Inc.
   c. Balco, Inc.

3. Top-Loading Classification(s): Medium, heavy, and extra-heavy duty.

2.12 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum, unless otherwise indicated and as needed for pipe sizes.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 9-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Not used.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
11. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

    a. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48, Class 35 gray iron, unless otherwise indicated and to match existing manhole frames and covers.
    b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 15-mil minimum thickness applied to all surfaces, unless otherwise indicated.

B. Cast-in-Place Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete, as required to prevent flotation.
2. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
3. Steps: Not used.
4. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

    a. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48, Class 35 gray iron, unless otherwise indicated and to match existing frames and covers.
    b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint 15-mil minimum thickness applied to all surfaces, unless otherwise indicated.

2.13 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.14 POLYMER-CONCRETE, CHANNEL DRAINAGE SYSTEMS

A. Description, General: Modular system of precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling. Include number of units required to form total lengths indicated.

B. Manufacturers:

1. ABT, Inc.
2. ACO Polymer Products, Inc.
3. Innovative Plastics Products. Inc.
4. Mea-Josam Div.; Josam Company.
5. Strongwell; Lenoir City Div.

C. Sloped-Invert, Polymer-Concrete Systems: Include the following components:

1. Channel Sections: Interlocking-joint, precast, modular units with end caps. Include inside width and depth as indicated with rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.

   a. Frame: Include gray-iron or steel frame for grate.

2. Grates with manufacturer's designation "Heavy Duty," with slots or perforations that fit recesses in channels.

   a. Material: Gray iron.

3. Covers: Solid gray iron, if indicated.
4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

D. Narrow-Width, Level-Invert, Polymer-Concrete Systems: Include the following components:

1. Channel Sections: Interlocking-joint, precast, modular units with end caps. Include 5-inch inside width and 9-3/4-inch deep, rounded bottom, with level invert and with NPS 4 outlets in number and locations indicated.
2. Grates with slots or perforations that fit recesses in channels.

   a. Material: Gray iron.

3. Covers: Solid gray iron, if indicated.
4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

E. Wide-Width, Level-Invert, Polymer-Concrete Systems: Include the following components:

1. Channel Sections: Interlocking-joint, precast, modular units with end caps. Include 8-inch inside width and 13-3/4-inch-deep, rounded bottom, with level invert and with outlets in number, sizes, and locations indicated.
2. Grates with slots or other openings that fit recesses in channels.

   a. Material: Gray iron.

3. Covers: Solid gray iron, if indicated.
4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

F. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.

G. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.15 CATCH BASINS

A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
2. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
3. Top Section: Flat-slab-top type with hole for frame and grate is indicated.
4. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
5. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
6. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match frame and grate.
7. Steps: Not Used.
8. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section. Size sections and box or manhole to fit pipes without necesary

B. Cast-in-Place Concrete, Catch Basins: Construct of reinforced concrete; designed according to ASTM C 890 for structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Bottom, Walls, and Top: Reinforced concrete.

2. Channels and Benches: Concrete.
3. Steps: Not used.

C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum, unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

D. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter flat grate with small, square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

2.16 STORMWATER INLETS

A. Gutter Inlets: Horizontal gutter opening, of materials and dimensions indicated. Include heavy-duty frames and grates. All grates to be bicycle safe.

B. Combination Inlets: Vertical curb and horizontal gutter openings, of materials and dimensions indicated. Include heavy-duty frames and grates.

2.17 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregular size and shape, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

C. Filter Stone: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size, graded stone.

D. Energy Dissipaters: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton average weight armor stone, unless otherwise indicated.

2.18 DRY WELLS

A. Description: ASTM C 913, precast, reinforced, perforated concrete manholes with ring and cover, frame and grate, or lid as indicated and include the following:

1. Floor: Cast-in-place concrete support ring.
2. Cover: Liftoff-type concrete cover with cast-in lift rings.
3. Wall Thickness: 4 inches minimum with 1-inch diameter or 1-by-3-inch maximum slotted perforations arranged in rows parallel to axis of ring.

   a. Total Free Area of Perforations: Approximately 15 percent of ring interior surface.
   b. Ring Construction: Designed to be self-aligning.

4. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.

   a. Flexible or rigid couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping: Use[any of] the following pipe materials for each size range:
1. PVC water-service pipe; PVC Schedule 40, water-service-pipe fittings; and solvent-cemented joints.
2. PVC sewer pipe and fittings; gaskets; and gasketed joints.
3. Class [1] [2] [3], nonreinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
4. Ductile-iron culvert pipe, ductile-iron standard or compact fittings, gaskets, and gasketed joints.
5. Reinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
6. Corrugated steel pipe and fittings, standard and special-joint bands, and banded joints.
7. Corrugated aluminum pipe and fittings, standard and special-joint bands, and banded joints.
8. Corrugated PE pipe and fittings, silttight couplings, and coupled joints.

D. Force-Main Pressure Piping: Use[any of] the following pipe materials for each size range:

1. PVC Schedule 80, water-service pipe; PVC Schedule 80, water-service-pipe fittings; and solvent-cemented joints.
2. Ductile-iron pressure pipe; ductile-iron standard or compact fittings; gaskets; and gasketed joints.
3. PVC pressure pipe, PVC pressure fittings, gaskets, and gasketed joints.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at slope indicated.
2. Install piping with restrained joints at tee fittings and at changes in direction for pressure pipe. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with cover indicated.
4. Notify engineer of clearance problems that would result in changes to grade and alignment.
5. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install ductile-iron culvert piping according to ASTM A 716.
7. Install ductile-iron and special fittings according to AWWA C600 or AWWA M41.
8. Install corrugated steel piping according to ASTM A 798/A 798M.
9. Install corrugated aluminum piping according to ASTM B 788/B 788M.
10. Install PVC cellular-core piping according to ASTM D 2321 and ASTM F 1668.
11. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
12. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
13. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
14. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

G. Install force-main pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
2. Install piping with line and grade as indicated or below frost line if not inidcated.
3. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
4. Install ductile-iron special fittings according to AWWA C600.
5. Install PVC pressure piping according to AWWA M23 or ASTM D 2774 and ASTM F 1668.
6. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.

3.4 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure drainage piping according to the following:
   1. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
   2. Join ductile-iron and special fittings according to AWWA C600 or AWWA M41.
   3. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
   4. Join corrugated aluminum sewer piping according to ASTM B 788/B 788M.
   5. Join corrugated PE piping according to CPPA 100 and the following:

      a. Use silttight couplings for Type 1, silttight joints.

   6. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cement joints.
   7. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
   8. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
   9. Join nonreinforced-concrete sewer piping according to ASTM C 14and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
   10. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
   11. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.

C. Join force-main pressure piping according to the following:

   1. Join ductile-iron pressure piping according to AWWA C660 or AWWA M41 for push-on joints.
   2. Join ductile-iron special fittings according to AWWA C660 or AWWA M41 for push-on joints.
   3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
   4. Join PVC water-service piping according to ASTM D 2855 for solvent-cemented joints.

D. Join dissimilar pipe materials with pressure-type couplings.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use same pipe type as sewer line that the cleanout is connected to. Install piping so cleanouts open in direction of flow in sewer pipe.

   1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
   2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
   3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
   4. Use extra-heavy-duty, top-loading classification cleanouts in roads areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 12 inches around outside of cover. At contractors option, a square block can be used that is at least 12-inches wider that the cover. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.6 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use light-duty, top-loading classification drains in earth or unpaved foot-traffic areas.
2. Use medium-duty, top-loading classification drains in paved foot-traffic areas.
3. Use heavy-duty, top-loading classification drains in vehicle-traffic service areas.
4. Use extra-heavy-duty, top-loading classification drains in roads areas.

B. Embed drains in 4-inch minimum depth of concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

F. Embed trench sections in 4-inch minimum concrete around bottom and sides.

3.7 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections according to ASTM C 891.

C. Construct cast-in-place manholes as indicated.

D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.

E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

3.8 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

C. Align boxes so that frame and grates are square to adjacent sidewalks, curbs or roadways.

3.9 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

3.10 DRY WELL INSTALLATION

A. Excavate hole to diameter of at least 24 inches greater than outside of dry well. Do not extend excavation into ground-water table.
   1. Install filter fabric as indicated. Provide sufficient filter fabric to lap sliced areas at least 12-inches.

B. Install precast, concrete-ring dry wells according to the following:

   1. Assemble rings to depth indicated.
   2. Extend rings to height where top of cover will be approximately 8 inches below finished grade.
   3. Backfill bottom of inside of rings with filtering material to level at least as indicated on plans.
   4. Extend effluent inlet pipe 12 inches into rings and terminate into side of tee fitting.
   5. Backfill around outside of rings with filtering material to top level of rings and to depth indicated.
   6. Install cover over top of rings.

3.11 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.12 DRAINAGE SYSTEM INSTALLATION

A. Assemble and install components according to manufacturer's written instructions.

B. Install with top surfaces of components, except piping, flush with finished surface.

C. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

D. Embed channel sections and drainage specialties in 4-inch minimum concrete around bottom and sides.

E. Fasten grates to channel sections if indicated.

F. Assemble channel sections with flanged or interlocking joints.

G. Embed channel sections in 4-inch minimum concrete around bottom and sides.

3.13 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

B. Connect force-main pressure piping to building's storm drainage force mains specified in Division 22 Section "Facility Storm Drainage Piping." Terminate piping where indicated.

   1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye

fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Connect to sediment interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.14 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section "Earth Moving."

3.15 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.16 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Crushed, broken, cracked, or otherwise damaged piping.

d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
b. Option: Test plastic piping according to ASTM F 1417.
c. Option: Test concrete piping according to ASTM C 924.

6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig

a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.17 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION - 334100

SECTION 334600 SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes subdrainage systems for the following:

1. Foundations.
2. Underslab areas.
3. Plaza decks.
4. Retaining walls.
5. Landscaped areas.

B. Related Sections include the following:

1. Division 07 waterproofing Sections for molded-sheet drainage panels.

1.3 DEFINITIONS

A. HDPE: High-density polyethylene plastic.

B. PE: Polyethylene plastic.

C. PVC: Polyvinyl chloride plastic.

D. Subdrainage: Drainage system that collects and removes subsurface or seepage water.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Perforated-wall pipe and fittings.
2. Solid-wall pipe and fittings.
3. Drainage conduits.
4. Drainage panels.
5. Geotextile filter fabrics.

B. Approval of waterproofing manufacturer's service agent for use of drainage panels against and for waterproofing membrane protection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to the "Piping Applications" Article in Part 3 for applications of pipe, tube, fitting, and joining materials.

2.3 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings:

1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
2. NPS 8 and Larger: ASTM F 667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
3. Couplings: Manufacturer's standard, band type.

B. Perforated PVC Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.

2.4 SOLID-WALL PIPES AND FITTINGS

A. PVC Sewer Pipe and Fittings: ASTM D 3034, SDR 35, bell-and-spigot ends, for gasketed joints.

1. Gaskets: ASTM F 477, elastomeric seal.

2.5 SPECIAL PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant metal tension band and tightening mechanism on each end.

1. Sleeve Materials:

a. For Concrete Pipes: ASTM C 443, rubber.
b. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
c. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

d. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant metal tension band and tightening mechanism on each end.
3. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant metal tension band and tightening mechanism on each end.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts: ASME A112.36.2M; with round-flanged, cast-iron housing; and secured, scoriated, Medium-Duty Loading class, cast-iron cover. Include cast-iron ferrule and countersunk, brass cleanout plug.

B. PVC Cleanouts: ASTM D 3034, PVC cleanout threaded plug and threaded pipe hub. Include, cast-iron housing; and secured, scoriated, Medium-Duty Loading class, cast-iron cover. Include cast-iron ferrule and countersunk, brass cleanout plug.

2.7 DRAINAGE CONDUITS

A. Single-Pipe Drainage Conduits: Prefabricated geocomposite with perforated corrugated core molded from HDPE complying with ASTM D 3350 and wrapped in geotextile filter fabric.

1. Manufacturers:

a. Advanced Drainage Systems.
b. Engineer approved equal

2. Filter Fabric: Nonwoven, PP geotextile.
3. Fittings: HDPE with combination NPS 4 and NPS 6 outlet connection or sized to match pipe size.
4. Couplings: Corrugated HDPE band.
5. Use solid pipe (storm drain pipe) for pipe and fittings after drainage area. Do not use HDPE perforated or solid wall pipe for storm drain pipe.

2.8 SOIL MATERIALS

A. Backfill, drainage course, impervious fill, and satisfactory soil materials are specified in Division 31 Section "Earth Moving."

2.9 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.

1. Structure Type: Nonwoven, needle-punched continuous filament or woven, monofilament or multifilament.
2. Style(s): Flat and sock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.3 PIPING APPLICATIONS

A. Underground Subdrainage Piping:

1. Perforated PE pipe and fittings, couplings, and coupled joints.
2. Perforated PVC sewer pipe and fittings for loose, bell-and-spigot joints.

B. Underslab Subdrainage Piping:

1. Perforated PE pipe and fittings, couplings, and coupled joints.
2. Perforated PVC sewer pipe and fittings and loose, bell-and-spigot joints.

C. Header Piping:
1. PVC sewer pipe and fittings, couplings, and coupled joints.

3.4 CLEANOUT APPLICATIONS

A. In Underground Subdrainage Piping:

1. At Grade in Earth: Cast-iron or PVC cleanouts.
2. At Grade in Paved Areas: Cast-iron cleanouts.

B. In Underslab Subdrainage Piping:

1. In Equipment Rooms and Unfinished Areas: Cast-iron cleanouts.
2. In Finished Areas: Refer to architect’s plans and requirements.

3.5 FOUNDATION DRAINAGE INSTALLATION

A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

B. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4.

C. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

D. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.

E. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

F. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.

G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

I. Place initial backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.6 UNDERSLAB DRAINAGE INSTALLATION

A. Excavate for underslab drainage system after subgrade material has been compacted but before drainage course has been placed. Include horizontal distance of at least 6 inches between drainage pipe and trench walls. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for underslab subdrainage.

F. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping with drainage course to elevation of bottom of slab, and compact and wrap top of drainage course with flat-style geotextile filter fabric.

H. Install horizontal drainage panels as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at inside edge of footings.

3. Place drainage panel over drainage pipe with core side up. Peel back fabric and wrap fabric around pipe. Locate top of core at bottom elevation of floor slab.
4. Butt additional panels against other installed panels. If panels have plastic flanges, overlap installed panel with flange.

3.7 RETAINING-WALL DRAINAGE INSTALLATION

A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

B. Place supporting layer of drainage course over compacted subgrade to compacted depth of not less than 4 inches.

C. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

D. Install drainage piping as indicated in Part 3 "Piping Installation" Article for retaining-wall subdrainage.

E. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

F. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.

G. Place drainage course in layers not exceeding 3 inches in loose depth; compact each layer placed and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

I. Fill to Grade: Place satisfactory soil fill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

3.8 LANDSCAPING DRAINAGE INSTALLATION

A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Install drainage conduits as indicated in Part 3 "Piping Installation" Article for landscaping subdrainage with horizontal distance of at least 6 inches between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with flat-style geotextile filter fabric before installation. Connect fabric sections with adhesive or tape.

E. Add drainage course to top of drainage conduits.

F. After satisfactory testing, cover drainage conduit to within 12 inches of finish grade.

G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

3.9 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Foundation Subdrainage: Install piping pitched down in direction of flow, at slopes and grades indicated.
2. Underslab Subdrainage: Install piping pitched down in direction of flow, at slopes and grades indicated.
3. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping pitched down in direction of flow, at slopes and grades indicated. However, when water discharges through wall weep holes, pipe may be installed with a minimum slope of zero percent.
4. Landscaping Subdrainage: Install piping pitched down in direction of flow, at slopes and grades indicated.
5. Lay perforated pipe with perforations down.
6. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install PE piping according to ASTM D 2321.

D. Install PVC piping according to ASTM D 2321.

E. Install concrete piping according to ACPA's "Concrete Pipe Handbook."

3.10 PIPE JOINT CONSTRUCTION

A. Join PE pipe, tubing, and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties."

B. Join perforated, PE pipe and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties"; or according to ASTM D 2321.

C. Join PVC pipe and fittings according to ASTM D 3034 with elastomeric seal gaskets according to ASTM D 2321.

D. Join perforated PVC pipe and fittings according to ASTM D 2729, with loose bell-and-spigot joints.

E. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.11 CLEANOUT INSTALLATION

A. Cleanouts for Foundation, Retaining-Wall, and Landscaping Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. In vehicular-traffic areas, set cleanout frames and covers in a cast-in-place concrete anchor. Set top of cleanout flush with grade.
3. In nonvehicular-traffic areas, use PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor. Set top of cleanout plug 1 inch above grade.

B. Cleanouts for Underslab Subdrainage:

1. Install cleanouts and riser extensions as indicated on plumbing plans and as coordinated with the architectural plans.

3.12 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system.

3.13 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping.

1. Install PE warning tape or detectable warning tape over ferrous piping.
2. Install detectable warning tape over nonferrous piping and over edges of underground structures.

3.14 FIELD QUALITY CONTROL

A. Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.15 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600

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APPENDIX

Geotechnical Information: Data on the indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings and is made available solely for the convenience of the Contractor. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn therefrom by the Contractor.

Additional test borings and exploratory tests may be made by the Contractor as desired, at no cost to the owner.

Gordon Spilker Huber
Geotechnical Consultants, Inc.

REPORT
GEOTECHNICAL STUDY
PROPOSED RESIDENTIAL LIFE HOUSING
BUILDING NOS. 2 AND 3
APPROXIMATELY 4100 SOUTH 1350 EAST
SOUTH END OF
WEBER STATE UNIVERSITY CAMPUS
OGDEN, UTAH
MHTN PROJECT NO. 2010543

Submitted To:

MHTN Architects, Inc.
420 East South Temple, Suite 100
Salt Lake City, Utah 84111

Submitted By:

Gordon Spilker Huber Geotechnical Consultants, Inc.
4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123

December 15, 2010

Job No. 0149-015-10

GSH
Gordon Spilker Huber
Geotechnical Consultants, Inc.

December 15, 2010
Job No. 0149-015-10

MHTN Architects, Inc.
420 East South Temple, Suite 100
Salt Lake City, Utah 84111

Attention: Mr. Mick Gaviglio, AIA

Gentlemen:

Re: Report
Geotechnical Study
Proposed Residential Life Housing Building Nos. 2 and 3
Approximately 4100 South 1350 East
South End of Weber State University Campus
Ogden, Utah
MHTN Project No. 2010543

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed Residential Life Housing Buildings Nos. 2 and 3, which are at approximately 4100 South 1350 East, at the south end of the Weber State University Campus in Ogden, Utah. Building No. 2 will be constructed at the site of the existing Wasatch Hall (to be demolished). Building No. 3 will be constructed within the east parking area of the existing Promontory Tower Building (also to be demolished). The general location of the site with respect to major topographic features and existing facilities, as of 1998, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing the proposed location of the new structures and pavements in relation to existing structures, pavements and topography, is presented on Figure 2, Site Plan. The locations of the borings drilled in conjunction with this study are presented on Figure 2.

During the course of this study, many of the conclusions and recommendations were presented to the design team.

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1.2 OBJECTIVES AND SCOPE

The objectives and scope of our study were planned in discussions between Mr. Mick Gaviglio of MHTN Architects, Inc. (MHTN) and Mr. Bill Gordon of Gordon Spilker Huber Geotechnical Consultants, Inc. (GSH).

In general, the objectives of this study were to:

1. Accurately define and evaluate the subsurface soil and groundwater conditions across the site.

2. Provide appropriate foundation, earthwork, subdrain, and pavement recommendations to be utilized in the design and construction of the proposed structures.

In accomplishing these objectives, our scope has included the following:

1. A field program consisting of the drilling, logging, and sampling of 14 borings.

2. A laboratory testing program.

3. An office program consisting of the correlation of available data, engineering analyses, and the preparation of this summary report.

1.3 AUTHORIZATION

Authorization was provided by returning a signed copy of our Professional Services Agreement No. 10-0709-rev1 dated July 20, 2010 and executed on October 21, 2010.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration borings, projected groundwater conditions, and the layout and design data discussed in Section 2., Proposed Construction, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.

2. PROPOSED CONSTRUCTION

The proposed Residential Life Housing Buildings Nos. 2 and 3 will be three levels in height. Building No. 2 will be located where the existing Wasatch Hall is presently located and will have a plan area of 30,295 square feet. Based on preliminary design layout, Building No. 2 will have one level partially below grade with a walkout along the west. The lower level will extend down to roughly 12 feet below existing grade along the east and from 0 to 3 feet below existing grade along the west.

Building No. 3 will be located within the present east Promontory Tower parking lot and have a plan area of 11,680 square feet. The current planned main level floor elevation will be near existing grade at the south end and as much as six feet above existing grade at the north end.

Below grade, portions of the structures will be of reinforced concrete construction. Above grade, the structures will be constructed of light steel-frame and metal studs with exterior masonry panels.

Projected maximum real column and wall loads were provided by the project structural engineer, Mr. Jeremy Achter of ARW Engineers. Real loads are defined as the total of all dead plus frequently applied (reduced) live loads. The projected columns and wall loads will be on the order of 150 kips and 9 kips per lineal foot, respectively, for Building No. 3. For Building No. 2, column and wall loads of 265 kips and 12 kips per lineal foot, respectively, are projected. At-grade slab loads will be relatively light, on the order 150 to 200 pounds per square foot.

A new at-grade paved parking and roadway entrance from 4100 South will be constructed at the west edge of the development and where the present Promontory Tower is located. The existing easterly most parking lot east of the existing Wasatch Hall will remain and receive an overlay of two inches. Projected traffic in the parking areas should consist of a light volume of automobiles and light trucks and occasional medium-weight trucks. In primary roadway areas, traffic is projected to consist of a moderate volume of automobiles and light trucks, a light volume of medium-weight trucks, and occasional heavy-weight trucks.

As part of the site development, there will be a moderate amount of earthwork in the form of cutting and filling to obtain desired grades. Cuts for the lower level of Building No. 2 could be as much as 12 feet and fills associated with Building No. 3 could be as much as 6 feet.

3. INVESTIGATIONS

3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions at the site, 14 borings were drilled to depths ranging from 5.0 to 41.5 feet below existing grade. Eight of the 14 borings were completed for Building No. 2 and the remaining 6 borings completed for

Building No. 3. The borings were drilled using a truck-mounted drill rig equipped with hollow-stem augers. Locations of the borings are presented on Figures 2.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the drilling operations, a continuous log of the subsurface conditions encountered was maintained. In addition, relatively undisturbed and small disturbed samples of the typical soils encountered were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications have been supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3N, Log of Borings. Soils were classified in accordance with the nomenclature described on Figure 4, Unified Soil Classification System.

A 3.25-inch outside diameter, 2.42-inch inside diameter drive sampler (Dames & Moore) was utilized in the majority of the subsurface sampling at the site. Additionally, a 2.0-inch outside diameter, 1.38-inch inside diameter drive sampler (SPT) was utilized at select locations and depths. The blow counts recorded on the boring logs were those required to drive the sampler 12 inches with a 140-pound hammer dropping 30 inches.

Following completion of drilling operations, a one and one-quarter-inch diameter slotted PVC pipe was installed in Borings B-1 through B-9A and Boring B-13 in order to provide a means of monitoring the groundwater fluctuations.

3.2 LABORATORY TESTING

3.2.1 General

In order to provide data necessary for our engineering analyses, a laboratory testing program was performed. The program included moisture and density, partial gradation, consolidation, and chemical tests. The following paragraphs describe the tests and summarize the test data.

3.2.2 Moisture and Density Tests

To aid in classifying the soils and to help correlate other test data, moisture and density tests were performed on selected undisturbed samples. The results of these tests are presented on the boring logs, Figures 3A through 3N.

3.2.3 Partial Gradation Test

To aid in classifying the soils, a partial gradation test was performed. Results of the test are tabulated on the following page.

Boring No.	Depth (feet)	Percent Passing No. 200 Sieve	Soil Classification
B-1	15.5	82.9	CL*

* Sample is portion of clay layers up to three inches thick within a generally fine sand layer.

3.2.4 Consolidation Tests

To provide data necessary for our settlement analyses, a consolidation test was performed on each of eight representative samples of the natural fine-grained clay and fine silty/clayey sand soils encountered at the site.

Test data indicates that the natural fine-grained soils are moderately over-consolidated and will exhibit moderate compressibility characteristics when loaded below the pre-consolidation pressure. The data obtained from these tests was used to calculate foundation settlement which could occur under the anticipated foundation loadings. Detailed results of the tests are maintained within our files and can be transmitted to you, upon your request.

3.2.5 Chemical Tests

To determine if the site soils will react detrimentally with concrete, chemical tests were performed on representative samples of the silty clay soils encountered in Borings B-5 and B-10 at a depth of five and one-half feet below existing grade. The results of the chemical tests are tabulated below:

Boring No.	Depth (feet)	Soil Classification	pH	Total Water Soluble Sulfate (mg/kg-dry)
B-5	5.5	CL	8.56	6.16
B-10	5.5	CL	8.91	6.32

4. SITE CONDITIONS

4.1 SURFACE

Each building site is located at the south end of Weber State University Campus and just south of 4100 South at approximately 1350 East in Ogden, Utah. These building sites are part of the planned Weber State University New Residential Life Housing development.

This new Residential Life Housing development will incorporate three new three-story residential structures, making a "U-"shape, as they surround a landscaped commons area (see Figure 2). New paved parking will be constructed along the south and west portions of the site, while existing parking to the east will remain and be upgraded.

Presently, the first of the three structures (Building No. 1) is under construction and is located at the south end of the proposed development. The existing Wasatch Hall, Stansbury Hall, and Promontory Tower housing structures located at the site will be demolished prior to new construction.

Building No. 2 will be located at the east end of the site where Wasatch Hall is presently located. Building No. 3 will be located within the current east asphalt concrete-paved parking lot associated with the Promontory Tower building at the west end of the site. The existing Stansbury Hall building is located near the middle of the overall development and within the planned landscaped commons area.

Overall, the site slopes moderately downslope to the northwest with some intermittent terraces/steepened slope portions. Total relief across the Building No. 2 footprint is on the order of 10 feet and roughly six feet across Building No. 3.

4.2 SUBSURFACE SOIL

4.2.1 Proposed Residential Life Housing Building No. 2 (Borings B-1 through B-8)

Borings B-1 through B-6 are located within the footprint of the proposed Building No. 2 and surround the existing Wasatch Hall building within lawn-covered landscaped areas. The lawn and root system/topsoil at the surface of the borings is roughly four inches thick. In Borings B-1 through B-5, surficial non-engineered fills exist below the lawn extending to depths of one and one-half feet thick in Boring B-5 to as much as eight feet thick in Boring B-3. The fills are predominately comprised of silty/sandy clays and silty sands. In Boring B-3, a layer of clean "pea"-sized gravel fill exists between depths of two and eight feet.

Borings B-7 and B-8 were located within the existing asphalt concrete-paved parking lot directly east of Wasatch Hall. The pavement surface at the boring locations consists of four to five inches of asphalt concrete overlying granular fills to depths of two and one-half to four and one-half feet. These granular fills consist primarily of silty and clayey sands and are likely structural fills placed in conjunction with the construction of the existing parking lot. A thin layer roughly six inches thick of base course fill was observed directly below the asphalt concrete in Boring B-7.

Natural subsurface soil conditions encountered below the fills and topsoil within Borings B-1 through B-7 consists of variable layers of silty/sandy clays and silty/clayey fine sands and extend to the maximum depth penetrated, 41.5 feet. The individual, predominately clay soil layers encountered range from 4.0 to 21.5 feet thick, contain occasional to numerous layers of fine

sands up to 4.0 inches thick, are medium stiff to stiff, moist to saturated, brown and grayish-brown in color, and are generally moderately over-consolidated.

The predominately silty/clayey fine sand layers encountered range from 4 to 17 feet thick, contain occasional to numerous layers of silty/sandy clay up to 3 inches thick, are loose to medium dense, moist to saturated, brown and grayish-brown in color, and will exhibit moderately high strength and low compressibility characteristics.

In Borings B-1 through B-8, it was common to see layers with vertical and/or steeply dipping bedding/layering of clay and fine sand between 10 to 20 feet below the surface. This type of layering is indicative of past seismic induced liquefaction-lateral/spreading.

Based on present soil conditions and analysis, liquefaction of the soils encountered at the boring locations during a future design seismic event is not likely to occur.

4.2.2 Building No. 3 (Borings B-9 and B-9A through B-13)

Borings B-9 and B-9A through B-13 are located with the planned footprint of Building No. 3. Subsurface soils encountered in these borings are generally consistent. At each boring, the surface is blanketed with asphalt concrete pavements ranging in thickness from four to six and one-half inches thick. The asphalt concrete is supported generally over six to seven inches of base course and at Boring B-9 includes an additional 12 inches of granular subbase fill. Below the pavement section, natural soils consist of predominately silty clay soils with occasional to numerous layers of silty and clayey fine sand up to four inches thick. These natural clay soils are medium stiff to stiff, moist to saturated, brown and grayish-brown in color, and moderately over-consolidated.

4.3 GROUNDWATER

Static groundwater depths observed in Borings B-1 through B-7 ranged from 5.2 to 13.2 feet below the surface with the gradient generally sloping down to the northwest following surface grade.

Static groundwater depths observed in Borings B-9 and B-9A through B-13 varied from a low flow artesian condition extending to the surface in Boring B-9 to a depth of 5.2 feet below the surface in Boring B-13. The measured groundwater gradient generally sloped down to the north following surface grade. Boring B-9 extends to a depth of 41.5 feet below the surface and appears to have tapped into an artesian layer. Water flowing out of Boring B-9 is approximately less than two to three gallons per minute. A shallow 5.0-foot deep boring, Boring B-9A was completed roughly 5.0 feet to the south of Boring B-9 and static groundwater was measured at a depth of 4.8 feet below the surface. According to state law, the artesian condition at Boring B-9 will have to be capped by a certified/licensed well driller.

The borings were completed over a period of several days beginning on November 11, 2010 and extending to November 16, 2010. Groundwater measurements taken on November 16, 2010 and December 1, 2010 are tabulated below:

Boring No.	Approximate Ground Surface Elevation (feet)**	Groundwater Depth (feet)	
		November 16, 2010	December 1, 2010
B-1	4706	12.6	9.8
B-2	4706	11.5	11.6
B-3	4706	12.9	13.2
B-4	4706	15.6	5.2 (potential slight artesian)
B-5	4706	5.5	9.5
B-6	4706	9.3	Not accessible-snow pile covered
B-7	4717	12.5	Not accessible-snow pile covered
B-8	4717	18.8	Not accessible-snow pile covered
B-9	4694	Surface artesian-less than 2 to 3 gallons/minute	Surface artesian-less than 2 to 3 gallons/minute
B-9A	4694	NGWE*** to 5.0	4.8
B-10	4694	6.0*	No PVC pipe installed
B-11	4691	7.0*	No PVC pipe installed
B-12	4691	6.0*	No PVC pipe installed
B-13	4688	6.0*	5.2

* Drilled same day; not stabilized.

** Top of boring elevation was estimated from the site topography provided on a drawing by MHTN. **It is recommended that Borings B-1 through B-6 at a minimum be surveyed for actual elevation.**

*** No groundwater encountered.

The area is known to have "perched" and confined (artesian) groundwater within layers of sands and silts interbedded in the clay soils. As indicated in the table above, groundwater is not at a specific elevation, but varies across the site.

Groundwater conditions will be affected seasonally, with the highest seasonal levels generally occurring during the late spring and early summer months.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The results of this study show that the proposed structures may be supported upon conventional spread and continuous wall foundations. Lightly to moderately loaded footings can be established directly upon suitable natural soil. To control settlements, more heavily loaded spread footings will require varying thicknesses of granular structural replacement fill extending to suitable natural soils.

Borings B-1 through B-6, located within the footprint of Building B-2, should be surveyed prior to final design is completed in order to accurately measure the groundwater elevation. Due to the variable "perched" and confined artesian conditions, it is recommended that:

1. All borings deeper than 10 feet be sealed to a depth of 10 feet below the lowest floor slab elevation by a licensed well driller.

2. Each building be built with an under-slab/perimeter subdrain system.

In addition, a subdrain shall be installed behind all retaining walls. For temporary and long-term stability, a cut-off trench drain should be considered within the slope above the new parking area as it ties into the south parking area presently being constructed. To facilitate construction, these drains should be put into place as far in advance of foundation construction as possible.

Depending on the time of year, groundwater seepage with the mass excavation may occur and need to be controlled during construction. Steep cuts with seeping groundwater will not be acceptable without a drainage buttress. A temporary buttress of fine and coarse gravel may be used at the base of the cut to help limit sloughing and maintain water collection and transport. Groundwater will need to be collected at isolated points along the base of the foundation cut and transported down-gradient.

In the following sections, detailed discussions and recommendations pertaining to subdrains earthwork, foundations, pavements, and the geoseismic setting of the site are provided.

5.2 SUBDRAINS

5.2.1 General

As previously discussed, groundwater appears to follow the local topography in "perched" sand and silt layers and is present in artesian aquifers. To facilitate long-term performance, at a minimum a foundation/chimney drain shall be installed along the upslope and sideslopes of perimeter subgrade foundation walls to aid in collecting lateral flows. To collect possible vertical seepage around the sealed borings, an under-slab drain is also recommended.

In conjunction with the current construction of Building No. 1, an upslope parking lot to the south of Building No. 1 is under construction. A water cut-off trench drain has been completed along the upslope edge of this parking lot. This parking lot will be extended to the west as part of the construction of Building No. 3. It is recommended that the water cut-off trench drain also be similarly extended to the west. Details for the cut-off trench can be provided once final grading plans are available.

If groundwater seepage occurs in the mass excavation during construction, the water can be collected with a temporary toe drain along the base of the excavation cut and then transported down gradient. Steep cuts with seeping groundwater will not be acceptable without a drainage buttress. A buttress of fine and coarse gravel may be used at the base of the cut to help limit sloughing and maintain water collection and transport.

5.2.2 Foundation/Chimney Drain

The perimeter subdrain should consist of a minimum of 4-inch diameter, slotted or perforated pipe, with the invert established at least 18 inches below the top of the lowest adjacent slab. The pipe should be encased in a one-half- to one-inch minus clean gap-graded crushed gravel extending two inches below and laterally around the pipe and up continuously at least 12 inches above the top of the lowest adjacent slab. The slope of the pipe should be at least 0.25 percent and connect to a suitable down-gradient point of gravity discharge. The same granular material could be utilized for the chimney drain against the subgrade walls. In all cases, the gravels must be separated from the natural soils or finer-grained backfill with a geotextile, such as Mirafi 140N or equivalent. As an alternate, a synthetic drain board, such as Miradrian or equivalent, can be used for the chimney drain. The chimney portion should extend up to 12 inches below the surface. The upper 12 inches should consist of low permeable soils, such as the on-site clays, to reduce surface infiltration into the drain system. Prior to installing the gravels, the outside subgrade walls adjacent to habitable inside areas must be appropriately waterproofed.

5.2.3 Under-Slab Drain

To collect possible vertical seepage around the sealed borings, an under-slab drain is recommended. This should consist of placing a six-inch layer of angular "free-draining" fill,

such as clean sands and gravel with less than 5 percent fines, directly below the floor slab. Floor subdrains should be installed longitudinally below the interior slabs-on-grade at intervals of approximately 30 feet. Floor drains should consist of a four-inch diameter perforated or slotted plastic or PVC pipe enclosed in clean gravel. The invert of a subdrain should be at least 12 inches below the top of finish floor elevation. The gravel portion of the drain should extend two inches laterally and two inches below the perforated pipe. To reduce the possibility of plugging, the gravel must be wrapped with a geotextile fabric, such as Mirafi 140N or equivalent. The floor may then tie into the perimeter drain and/or other convenient down-gradient drain.

5.3 EARTHWORK

5.3.1 Site Preparation

Initial site preparation will consist of the demolition and removal of the existing structures and all associated non-engineered fills, pavements, debris, surface vegetation, topsoil, root bulbs, sod, and any other deleterious materials extending out at least three feet beyond the perimeter of the new structures, exterior flatwork, and rigid pavements. Existing utilities will need to be relocated and/or abandoned to accommodate the new construction.

Trees, heavy brush, etc., and their associated root bulbs will require deeper removal depths. Old foundations should be completely removed below the new structure and to a minimum of one and one-half feet below top of asphalt concrete in proposed pavement areas. Vegetation and other deleterious materials should be removed from the site. Stripped topsoil will be unsuitable for structural fill, but may be stockpiled for subsequent landscaping purposes.

In proposed flexible pavement areas, all deleterious materials must be removed beneath an area extending at least three feet beyond the perimeter. However, existing non-engineered fills may remain provided that they do not contain deleterious material, are no more than three feet thick, and the upper nine inches are scarified, moisture prepared, and compacted to the requirements for structural fill. As an option to recompaction, the upper nine inches of non-engineered soils may be removed and replaced with granular subbase over proofrolled subgrade.

In general, granular materials resulting from demolition of existing pavements may be re-used as part of site grading engineered fill provided that it is free of debris and meets the fill requirements described later in this report. Any existing utilities in conflict with the new construction will need to be properly abandoned and/or relocated.

Subsequent to the above operations and prior to the placement of footings, structural site grading fill, floor slabs, or pavements, the exposed subgrade must be proofrolled by running moderate-weight rubber tire-mounted construction equipment uniformly over the surface at least three times. If excessively soft or otherwise unsuitable soils are encountered beneath footings, they must be removed. If unsuitable soil removal required is greater than two feet, GSH must be notified to make further recommendations. In pavement, floor slab, and outside flatwork areas,

unsuitable natural soils should be removed to a maximum depth of two feet and replaced with compacted granular structural fill.

5.3.2 Excavations

Subgrade walls for Building No. 2 may extend 3 to 12 feet below adjacent grade. The upper soils range from silty sands to silty clays with occasional to numerous sand and silt layers. These sand and silt layers may contain "perched"/confined groundwater and if so, will require flatter cut slopes, dewatering, and likely a drainage buttress of fine and coarse gravel at the base of the cut to help limit sloughing and maintain water collection and transport.

For general considerations, temporary construction excavations in cohesive soil, not exceeding four feet in depth and above or below the groundwater table, may be constructed with near-vertical sideslopes. Temporary excavations up to eight feet deep in fine-grained cohesive soils, above or below the water table, may be constructed with sideslopes no steeper than one-half horizontal to one vertical. Temporary excavations up to 14 feet deep in fine-grained cohesive soils, above or below the water table, may be constructed with sideslopes no steeper than three-quarters horizontal to one vertical. Excavations deeper than 14 feet are not anticipated at the site.

For granular (cohesionless) soils, construction excavations above the water table, not exceeding four feet, should be no steeper than one-half horizontal to one vertical. For excavations up to 14 feet, in granular soils and above the water table, the slopes should be no steeper than one horizontal to one vertical. Excavations encountering saturated cohesionless soils will be very difficult and will require very flat sideslopes and/or shoring, bracing, and dewatering.

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing are noted, immediate remedial action must be initiated.

5.3.3 Structural Fill

Structural fill is defined as all fill which will ultimately be subjected to structural loadings, such as imposed by footings, floor slabs, pavements, etc. Structural fill will be required as backfill over foundations and utilities, as site grading fill, and as replacement fill below footings. All structural fill must be free of sod, rubbish, topsoil, frozen soil, and other deleterious materials. Structural site grading fill is defined as fill placed over relatively large open areas to raise the overall grade. For structural site grading fill, the maximum particle size should generally not exceed four inches; although, occasional larger particles not exceeding eight inches in diameter may be incorporated if placed randomly in a manner such that "honeycombing" does not occur and the desired degree of compaction can be achieved. The maximum particle size within structural fill placed within confined areas should generally be restricted to two inches.

The on-site fine-grained soils may be utilized as structural site grading fill provided they meet the requirements stated herein. However, it should be noted that unless moisture control is maintained near optimum and the subgrade is stable, utilization of these natural on-site silty clay

soils as structural site grading fill will be very difficult, if not impossible, during wet and cold periods of the year. Additionally, these on-site, fine-grained soils are presently above optimum moisture content and would require drying prior to recompacting. Only granular soils are recommended as structural fill in confined areas, such as around foundations and within utility trenches, and as replacement fill below footings.

Imported granular structural fill should consist of a fairly well-graded mixture of sand and gravel with less than 20 percent fines. The plasticity index of imported fine-grained soils must not exceed 18 percent.

To stabilize soft subgrade conditions, a mixture of coarse gravels and cobbles and/or one and one-half- to two-inch gravel (stabilizing fill) should be utilized.

Non-structural site grading fill is defined as all fill material not designated as structural fill and may consist of any cohesive or granular soils not containing excessive amounts of degradable material.

5.3.4 Fill Placement and Compaction

Coarse gravel and cobble mixtures (stabilizing fill), if utilized, should be end-dumped, spread to a maximum loose lift thickness of 15 inches, and compacted by dropping a backhoe bucket onto the surface continuously at least twice. As an alternative, the fill may be compacted by passing moderately heavy construction equipment or large self-propelled compaction equipment at least twice. Subsequent fill material placed over the coarse gravels and cobbles must be appropriately placed and compacted so that the "fines" are "worked into" the voids in the underlying coarser gravels and cobbles.

All other structural fill should be placed in lifts not exceeding eight inches in loose thickness. All fills beneath the area extending out at least 3 feet from the perimeter of the proposed structures must be compacted to at least 95 percent of the maximum dry density as determined by the AASHTO[1] T-180 (ASTM[2] D-1557) compaction criteria.

Structural fills less than 5 feet thick, which are not beneath an area extending out at least 3 feet from the perimeter of the structure, should be compacted to at least 90 percent of the above-defined criteria. Structural fills greater than 5 feet thick, which are not beneath an area extending out at least 3 feet from the perimeter of the structure, should be compacted to at least 92 percent of the above-defined criteria. Structural fills greater than 8 to 10 feet thick are not anticipated at the site.

"Free-draining" granular fill utilized in chimney drains along the perimeter of the site structures should be spread to a maximum loose-lift thickness of 12 inches and compacted by running a

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1 American Association of State Highway and Transportation Officials
2 American Society for Testing and Materials

flat-plate hand-operated vibratory compactor over the surface of each lift continuously at least three times.

Subsequent to stripping and prior to the placement of structural site grading fill, the subgrade should be prepared as discussed in Section 5.3.1, Site Preparation, of this report. In confined areas, subgrade preparation should consist of the removal of all loose or disturbed soils.

Non-structural fill may be placed in lifts not exceeding 12 inches in loose thickness and compacted by passing construction, spreading, or hauling equipment over the surface at least twice.

5.3.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (flatwork, floor slabs, roads, etc.) should be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill should be proofrolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proofrolling may be performed by passing moderately loaded rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proofrolling, they should be removed to a maximum depth of two feet below design finish grade and replaced with structural fill.

Most utility companies and City-County governments are now requiring that Type A-1a or A-1b (AASHTO Designation – basically granular soils with limited fines) soils be used as backfill over utilities. These organizations are also requiring that in public roadways the backfill over major utilities be compacted over the full depth of fill to at least 96 percent of the maximum dry density as determined by the AASHTO T-180 (ASTM D-1557) method of compaction. We recommend that as the major utilities continue onto the site that these compaction specifications are followed.

The natural fine-grained cohesive soils are not recommended for use as trench backfill.

5.3.6 Areal Settlements

Areal settlements resulting from site grading fills as much as five to six feet should be on the order of three-eighths of an inch. These settlements are in addition to settlements induced by foundation and floor slab loads. To reduce the total settlement that the structure will realize, site grading fill must be placed as far in advance of other construction as possible. The majority of this settlement will occur during placement.

5.4 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.4.1 Design Data

The proposed structures may be supported upon conventional spread and continuous wall foundations. Lightly to moderately loaded footings can be established directly upon suitable natural soil. To control settlements, the more heavily loaded spread footings will require varying thicknesses of replacement granular structural fill (see Section 5.4.3, Settlements, for more detail). For design, considering the loading described in Section 2., Proposed Construction, of this report, the following parameters are provided:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches
Recommended Minimum Width for Continuous Wall Footings	- 18 inches
Minimum Recommended Width for Isolated Spread Footings	- 24 inches
Recommended Net Bearing Pressure for Real Load Conditions	- 3,000 pounds per square foot
Bearing Pressure Increase for Seismic Loading	- 50 percent*

* Should <u>not</u> be applied to maximum edge pressure during seismic loading for footings less than four feet wide established on granular soils.

The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade. Therefore, the weight of the footing and backfill to lowest adjacent final grade need not be considered. Real loads are defined as the total of all dead plus frequently applied live loads. Total load includes all dead and live loads, including seismic and wind.

5.4.2 Installation

Under no circumstances should the footings be established upon soft, loose or disturbed soils, non-engineered fills, sod, rubbish, frozen soils, debris, or within ponded water. If the natural soils upon which the footings are to be established become loose or disturbed, they must be

removed and replaced with granular structural fill. If granular structural fill upon which the footings are to be established become disturbed, they should be recompacted to the requirements for structural fill.

The width of replacement fill below footings should be equal to the width of the footing plus one additional foot for each foot of fill thickness placed.

5.4.3 Settlements

Settlements of foundations will be dependent upon the loads imposed and the thickness of replacement granular fill beneath the footings. For multiple loading conditions, the projected settlements are tabulated below:

Footing Type	Load	Minimum Thickness of Replacement Granular Fill* (feet)	Projected Settlement (inches)
Spread	Up to 70 kips	0	¼ to ⅝
	70+ to 110 kips	1.0	½ to ⅝
	110+ to 170 kips	2.0	½ to ⅝
	170+ to 220 kips	3.0	½ to ⅝
	220+ to 265 kips	3.5	½ to ⅝
Wall	Up to 7 kips per lineal foot	0	¼ to ⅝
	7+ to 9 kips per lineal foot	1.0	½ to ⅝
	9+ to 11 kips per lineal foot	2.0	½ to ⅝
	11 to 12 kips per lineal foot	2.5	½ to ⅝

* This should consist of granular structural site grading fill and/or granular replacement fill.

5.5 LATERAL RESISTANCE

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.40 should be utilized. This can be increased to 0.45 for footings upon granular soils. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot. Below the water table, this

granular soil should be considered equivalent to a fluid with a density of 150 pounds per cubic foot.

A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

5.6 LATERAL PRESSURES

The main level of Building No. 2 will be partially buried along the upslope and sideslopes. Mass excavation for the structure may extend as much as 3 to 12 feet below grade.

The lateral pressure parameters, as presented within this section, are for backfills, which will consist of drained granular soil, placed and compacted in accordance with the recommendations presented herein. The lateral pressures imposed upon subgrade facilities will be basically dependent upon:

1. The relative rigidity and movement of the backfilled structure.

2. The backfill material.

3. The degree and method of compaction.

For active walls, such as retaining walls which can move outward (away from the backfill), granular backfill may be considered equivalent to a fluid with a density of 35 pounds per cubic foot in computing lateral pressures. For more rigid walls, such as basement walls, granular backfill may be considered equivalent to a fluid with a density of 45 pounds per cubic foot. For very rigid non-yielding walls, granular backfill should be considered equivalent to a fluid with a density of at least 60 pounds per cubic foot. The above values assume that:

1. The surface of the soils slope behind the wall is horizontal.

2. The fill within three feet of the wall will be compacted with hand-operated compacting equipment.

3. The compaction requirement is associated with landscaping fills.

If the backfill is compacted as a structural fill, the above values should be increased to 45, 60, and 90 pounds per cubic foot, respectively. If the granular fill within 3 feet of the moderately rigid wall consists of angular “free-draining” gravel, the value for structural fill may remain at 45 pounds per cubic foot.

For seismic loading, the following uniform pressures should be added by active and moderately rigid (basement) walls:

Wall height (feet)	Active Case Uniform Pressure (pounds per square foot)	Moderately Yielding Case Uniform Pressure* (pounds per square foot)
4	30	60
8	60	125
12	90	185

* Intermittent heights may be linearly interpolated.

5.7 FLOOR SLABS

Floor slabs may be established upon suitable natural soils, and/or upon structural fill extending to suitable natural soils. Under no circumstances should floor slabs be established upon loose or disturbed surficial soils, rubbish, non-engineered fills, deleterious materials, frozen soils, or within ponded water. In order to provide a capillary break to facilitate curing of the concrete and as a drain for possible artesian well seepage, it is recommended that floor slabs be directly underlain by at least six inches of "free-draining" angular fill, such as "pea" gravel or three-quarters- to one-inch minus clean gap-graded gravel.

The tops of all floor slabs in habitable areas must be established at least 2 feet above the highest anticipated normal water level or 18 inches above the maximum groundwater level controlled by subdrains.

Settlements of proposed at-grade floor slabs are projected to be less than one-quarter of an inch.

5.8 CEMENT TYPES

The laboratory tests indicate that the site soils contain negligible amounts of water soluble sulfates. Therefore, all concrete which will be in contact with the site soils may be prepared using Type I or IA cement.

5.9 PAVEMENTS

The silty clays (natural and existing non-engineered fills) will be the controlling subgrade for pavement design. These soils will exhibit poor pavement support characteristics when saturated or near saturated. Non-engineered fills may remain beneath the flexible pavement sections provided the soils are properly prepared, do not contain deleterious material, and are no more than three feet thick, as previously discussed in this report. Under no circumstances should rigid

pavements be established overlying non-engineered fills, even if properly prepared. For the above subgrade conditions and the anticipated traffic, the following pavement sections are recommended:

Parking Areas

(Light Volume of Automobiles and Light Trucks,
Occasional Medium-Weight Trucks,
and No Heavy-Weight Trucks)
[1 to 2 equivalent 18-kip axle loads per day]

Flexible:

2.5 inches	Asphalt concrete
7.0 inches	Aggregate base course
Over	Properly prepared non-engineered fills, suitable natural soils and/or structural site grading fill extending to suitable natural soils

Rigid pavements should not be established over non-engineered fill soils. If these soils are removed to suitable natural soils, the following section is recommended:

Rigid:

5.0 inches	Portland cement concrete (non-reinforced)
4.0 inches	Aggregate base course
Over	Properly prepared, suitable, natural subgrade soils and/or structural site grading fill extending to suitable, natural subgrade soils

Roadway Areas/ Fire Lane

(Moderate Volume of Automobiles and Light Trucks,
Light Volume of Medium-Weight Trucks and Occasional Heavy-Weight Trucks)
[3 to 5 equivalent 18-kip axle loads per day]

Flexible:

3.0 inches	Asphalt concrete
9.0 inches	Aggregate base course
Over	Properly prepared non-engineered fills, suitable natural soils and/or structural site grading fill extending to suitable natural soils

Rigid pavements should not be established over non-engineered fills or potentially collapsible soils. If these soils are removed to suitable natural soils, the following section is recommended:

Rigid:

6.0 inches	Portland cement concrete (non-reinforced)
4.0 inches	Aggregate base course
Over	Properly prepared, suitable, natural subgrade soils and/or structural site grading fill extending to suitable, natural subgrade soils

In dumpster areas, we recommend that the above rigid pavement section for roadways be utilized.

The above rigid pavement sections are for non-reinforced Portland cement concrete. Construction of the rigid pavement should be in sections 10 to 12 feet in width with construction or expansion joints or one-quarter depth saw-cuts on no more than 12-foot centers. Saw-cuts must be completed within 24 hours of the "initial set" of the concrete and should be performed under the direction of the concrete paving contractor. The concrete should have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch and contain 6 percent ±1 percent air-entrainment.

5.10 GEOSEISMIC SETTING

5.10.1 General

Most of the Utah municipalities adopted the International Building Code (IBC) 2009 on July 1, 2010. The IBC 2009 code determines the seismic hazard for a site based upon 2002 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points).

The structure must be designed in accordance with the procedure presented in Section 1613, Earthquake Loads, of the IBC 2009 edition.

5.10.2 Faulting

Based upon our review of available literature, no active faults are known to pass through or are immediately adjacent to the site. The site is located outside fault investigation zones identified by Weber County. The nearest active fault is the Weber segment of the Wasatch Fault, approximately one-half mile east of the site. The Wasatch Fault zone is considered capable of generating earthquakes as large as magnitude 7.3[3].

5.10.3 Site Class

For dynamic structural analysis, the Site Class D - Stiff Soil Profile as defined in Table 1613.5.2, Site Class Definitions, of the IBC 2006 can be utilized.

5.10.4 Ground Motions

The IBC 2006 code is based on 2002 USGS mapping, which provides values of short and long period accelerations for the Site Class B-C boundary for the Maximum Considered Earthquake (MCE). This Site Class B-C boundary represents a hypothetical bedrock surface and must be corrected for local soil conditions. The following table summarizes the peak ground and short and long period accelerations for a MCE event and incorporates a soil amplification factor for a Site Class D soil profile in the second column. Based on the site latitude and longitude (41.1876 degrees north and 111.9448 degrees west, respectively), the values for this site are tabulated on the following page.

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[3] Arabasz, W.J., Pechmann, J.C., and Brown, E.D., 1992, Observational seismology and the evaluation of earthquake hazards and risk in the Wasatch Front area, Utah, in Gori, P.L., and Hays, W.W., eds., Assessment of regional earthquake hazards and risk along the Wasatch Front, Utah: U.S. Geological Survey Professional Paper 1500-D, 36 p.

Spectral Acceleration Value, T Seconds	Site Class B-C Boundary [mapped values] (% g)	Site Class D [adjusted for site class effects] (% g)
Peak Ground Acceleration	55.8	55.8
0.2 Seconds, (Short Period Acceleration)	$S_S = 139.5$	$S_{MS} = 139.5$
1.0 Seconds (Long Period Acceleration)	$S_1 = 58.2$	$S_{M1} = 87.3$

The IBC 2006 code design accelerations (S_{DS} and S_{D1}) are based on multiplying the above accelerations (adjusted for site class effects) for the MCE event by two-thirds (⅔).

5.10.5 Liquefaction

The site is located in an area that has been identified by Weber County as having a "moderate" liquefaction potential. Liquefaction is defined as the condition when saturated, loose, finer-grained sand-type soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event.

According to the USGS map "Surface Geologic Map of the Weber Segment, Wasatch Fault Zone, Weber And Davis Counties, Utah" by Alan R. Nelson and Stephen F. Personius, 1993, Weber State University, including this site, are located within an area of Bonneville Lake cycle and younger lacustrine, marsh, and alluvial deposits, which have been redeposited by lateral spread caused by liquefaction during a passed seismic event. After redeposition, these soils are now less susceptible to liquefaction during a design seismic event. In fact, based on our findings and analysis, the potential for liquefaction at this site would be considered low. Additionally, it is believed and/or understood that the site has been subjected to subsequent seismic events similar to the one creating the lateral spread since the time of the lateral spread.

Calculations were performed using the procedures described in the 2008 Soil Liquefaction During Earthquakes Monograph by Idriss and Boulanger[4].

5.11 SITE OBSERVATIONS

As previously mentioned, non-engineered fills are present at the site to varying depths. Therefore, we recommend that a qualified geotechnical engineer observe the foundation excavations and building footprint to identify that the foundations, floor slabs, and rigid

[4] Idriss, I. M., and Boulanger, R. W. (2008), Soil liquefaction during earthquakes: Monograph MNO-12, Earthquake Engineering Research Institute, Oakland, CA, 261 pp.

pavements are supported on suitable natural soils and or structural fill extending to suitable natural soils.

We appreciate the opportunity of providing this service for you. If you have any questions or require additional information, please do not hesitate to contact us.

Respectfully submitted,

GSH Geotechnical Consultants, Inc.

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State of Utah No. 276476
Project Geotechnical Engineer

Reviewed by:

William J. Gordon, P.E.
State of Utah No. 146417
President/Senior Geotechnical Engineer

BNR/WJG:sn

Encl. Figure 1, Vicinity Map
Figure 2, Site Plan
Figures 3A through 3N, Log of Borings
Figure 4, Unified Soil Classification System

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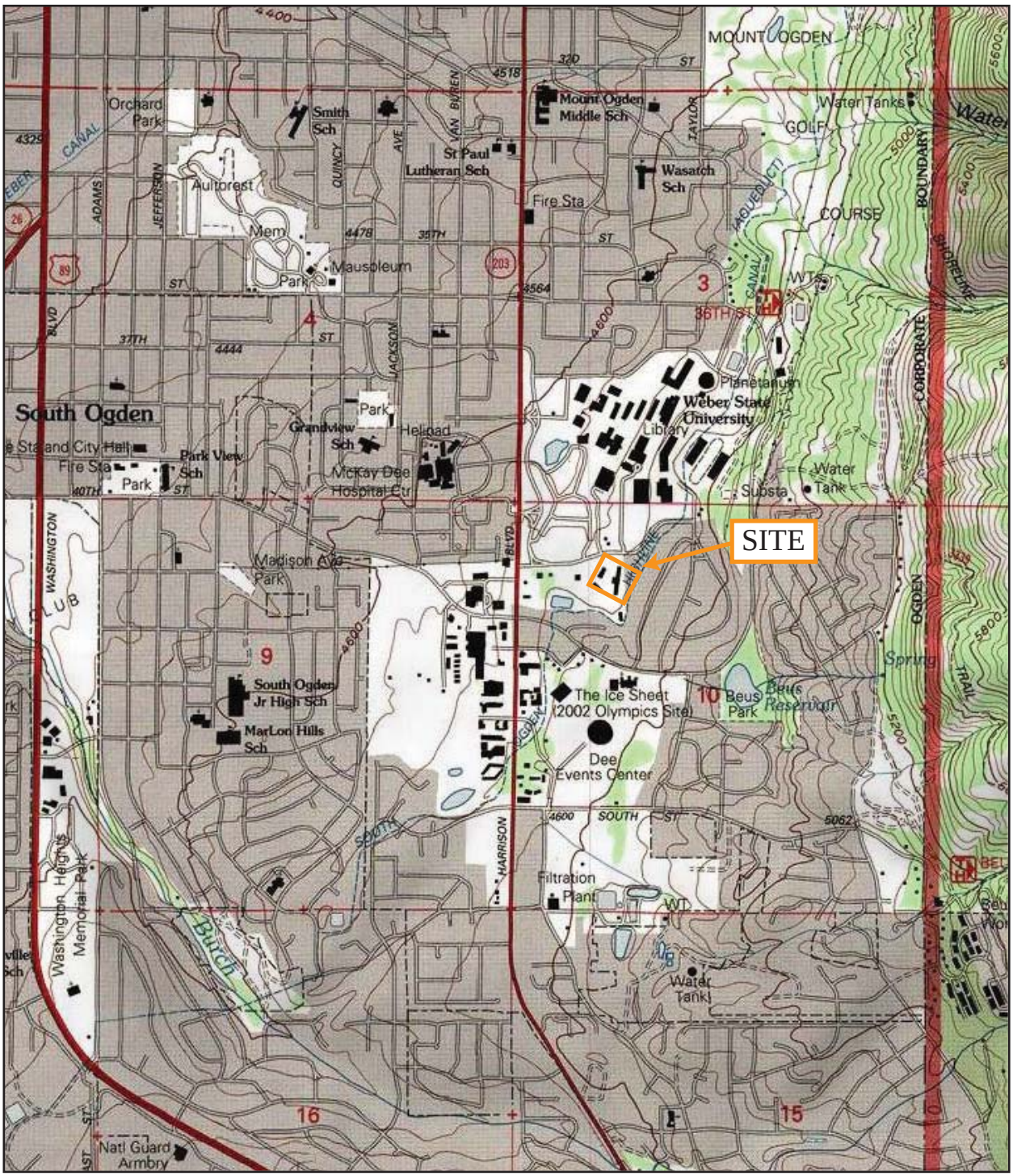
MHTN ARCHITECTS, INC.
JOB NO. 0149-015-10



SCALE IN FEET

1000 0 1000 2000

FIGURE 1
VICINITY MAP

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP
TITLED "OGDEN, UTAH"
DATED 1998

GSH
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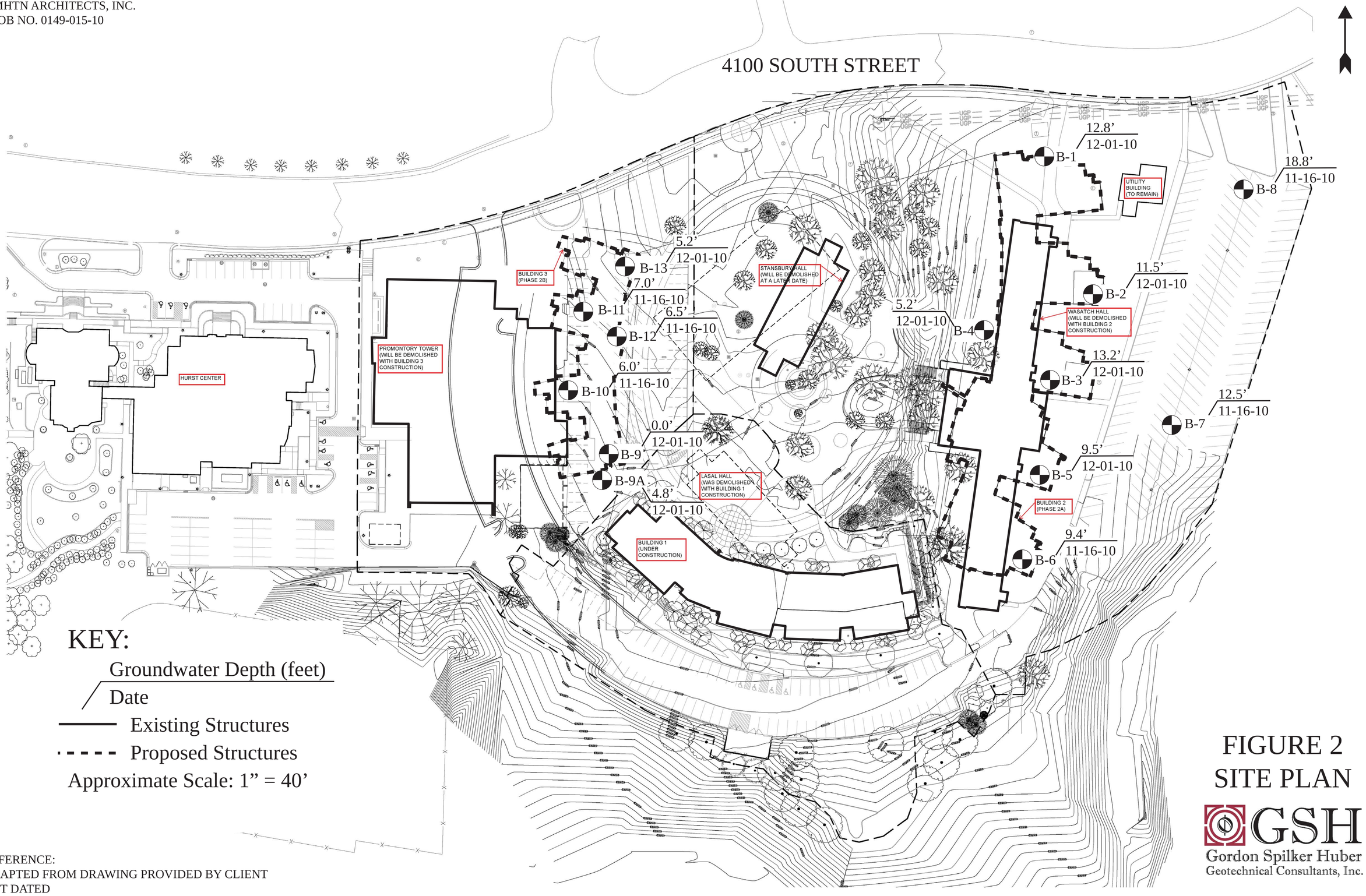
Geotechnical Consultants, Inc.

MHTN ARCHITECTS, INC.
JOB NO. 0149-015-10



REFERENCE:
ADAPTED FROM DRAWING PROVIDED BY CLIENT
NOT DATED

FIGURE 2
SITE PLAN

GSH
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Geotechnical Consultants, Inc.

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Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-11-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 12.8' (11-11-10) 12.8' (12-01-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY, FILL with some fine sand; major roots (topsoil) to 5"; dark brown (CL-FILL)									loose to 5" moist
		SILTY FINE SAND with trace organics; brown (SM)									medium stiff moist loose
				10							
			5								
		grades with occasional up to 1" thick layers of clayey sand; trace rootholes		17		8.8		105			
		grades with trace organics	10	18							
											saturated
		grades with occasional layers up to 3" thick of silty clay with some fine sand and vertical clay seams up to 1/2"	15	52		26.6	82.9				medium dense
		SILTY CLAY with numerous layers up to 3" thick of silty fine sand; dipping bedding approximately 60°; brown with oxidation mottling (CL)	20	26							saturated medium dense
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3A

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-11-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 12.8' (11-11-10) 12.8' (12-01-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		grades with occasional to numerous layers up to 1" thick of silty fine sand; dipping bedding approximately 70°; brown and gray		42							very stiff
		grades with numerous to alternating layers up to 4" thick of silty fine sand and silty clay with some fine sand; grayish-brown	30	18							stiff
		grades with occasional to numerous layers up to 2" thick of silty fine sand	35	9							very stiff
			40	6							stiff
		Stopped drilling at 40.0'. Stopped sampling at 41.5'. Installed 1-1/4" diameter slotted PVC pipe to 41.5'.	45								
			50								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3A
(con't)

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-12-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 12.5' (11-12-10) 11.7' (12-01-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface									
		SILTY FINE SAND, FILL with occasional fine gravel; trace organics; major roots (topsoil) to 4"; brown (SM-FILL)	0								loose to 4" moist
				25							moist
		SILTY FINE SAND brown (SM)									loose
			5	12							
		SILTY CLAY with some fine sand; cemented nodules; brown with oxidation (CL)									very moist stiff
				13		25.3		99			
		grades with occasional layers up to 1" thick of silty fine sand	10								
	▼	**SILTY FINE SAND** with numerous to alternating layers up to 2" thick of silty clay with some fine sand and mottling in clay; brown (SM)									saturated very stiff
				29							
			15								
		MIXED SILTY CLAY with vertical silty sand layers; distorted, possibly from past liquefaction events; brown (CL)									saturated very stiff/ medium dense
				38							
		Stopped drilling at 18.0'.	20								
		Stopped sampling at 19.5'.									
		Installed 1-1/4" diameter slotted PVC pipe to 19.5'.									
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3B

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-12-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 12.0' (11-12-10) 13.2' (12-01-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY, FILL with some fine sand; major roots (topsoil) to 4"; dark brown (CL-FILL)									loose to 5" moist medium stiff
		FINE GRAVEL, FILL with trace silt; pea gravel; grayish-brown (GP-FILL)		2							moist very loose
			5	2							
		SILTY CLAY with some fine sand and occasional to numerous layers up to 1" thick of silty fine sand; brown with mottling (CL)									moist stiff
			10	7							
	▼										saturated
		SILTY FINE SAND with some clay/SILTY CLAY with some fine sand; brown with mottling (SM/CL)	15	27							saturated medium dense/ very stiff
		grades with near-vertical bedding/partings of sand and clay layers	20	24							very stiff
		Stopped drilling at 20.0'. Stopped sampling at 21.5'. Installed 1-1/4" diameter slotted PVC pipe to 21.5'.	25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3C

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-12-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 18.0' (11-12-10) 5.2' (12-01-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY, FILL with some fine sand; major roots (topsoil) to 4"; brown (CL-FILL)									loose to 4"+ moist medium stiff
		grades black with mottling		29							very stiff
		SILTY CLAY with some fine sand; brown (CL)	5								
		grades with rootholes and occasional layers up to 1" thick of silty fine sand; brown with oxidation mottling		38		19.0		99			
		grades with occasional layers up to 1/4" thick of silty fine sand; mottling in clay	10	35							
		SILTY FINE SAND with occasional to numerous layers up to 2" thick of silty fine clay; vertical bedding/layers of clay and sand; some distortion; brown (SM)									moist very stiff/ medium dense
			15	50							
		grades with occasional layers up to 1" thick of silty fine sand; brown									saturated
			20	21							very stiff
		Stopped drilling at 19.0'. Stopped sampling at 20.5'. Installed 1-1/4" diameter slotted PVC pipe to 20.5'.	25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3D

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-12-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 12.0' (11-12-10) 9.5' (12-01-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface									
		SILTY CLAY, FILL with some fine sand; major roots (topsoil) to 4"; dark brown (CL-FILL)	0								loose to 4"+ moist
		SILTY CLAY with some fine sand and occasional layers up to 1/4" thick of silty fine sand; brown with mottling (CL)									medium stiff moist
				34							very stiff
			5	32		21.9		103			very moist
		grades with occasional to numerous layers up to 2" thick of silty fine sand with some vertical sand layers in clays	10	25							very moist very stiff
											saturated
		grades with occasional to numerous layers up to 4" thick of silty fine sand and occasional to some vertical sand layers	15	17		27.9		95			stiff
		CLAYEY FINE SAND with numerous layers up to 2" thick of silty clay; brown (SC)									saturated stiff
			20	14							
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3E

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-12-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 12.0' (11-12-10) 9.5' (12-01-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
				3							medium stiff
		SILTY CLAY with some fine sand and occasional layers up to 1" thick of silty fine sand; grayish-brown (CL)	30	7							saturated stiff
		Stopped drilling at 30.0'. Stopped sampling at 31.5'. Installed 1-1/4" diameter slotted PVC pipe to 31.5'.	35								
			40								
			45								
			50								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3E
(con't)

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-15-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 12.0' (11-15-10) 9.3' (11-16-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface									
		SILTY CLAY with some fine sand; major roots (topsoil) to 4"; brown (CL)	0								loose to 4"+ moist very stiff
				37							
		SILTY SAND with vertical clay layers/bedding up to 1/2" thick throughout; occasional horizontal clay layers up to 2" thick; brown with light brown mottling (SM)									moist very stiff
			5	33							
		SILTY CLAY with occasional layers up to 1" thick of silty sand; brown with mottling (CL)									very moist very stiff
	▼			27							
			10								
		CLAYEY FINE SAND with occasional to numerous layers up to 2" thick of silty clay; brown (SC)									very moist saturated stiff
				15		29.2		95			
			15								
		SILTY CLAY with numerous layers up to 1" thick of silty sand; brown (SM)									saturated stiff
				14							
		Stopped drilling at 18.0'.	20								
		Stopped sampling at 19.5'.									
		Installed 1-1/4" diameter slotted PVC pipe to 19.5'.									
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3F

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-15-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 18.0' (11-15-10) 12.5' (11-16-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		5.0" ASPHALT CONCRETE PAVEMENT									
		6.0" ROADBASE FILL brown (SM/GM-FILL)									moist medium dense
		SILTY FINE SAND, FILL dark brown and brown (SM-FILL)									moist medium dense
				10		11.4		103			loose
		CLAYEY FINE SAND brown (SC)	5	21							moist loose
		SILTY CLAY with some fine sand and occasional layers up to 2" thick of clayey fine sand; dipping bedding approximately 80° and some vertical layers of clayey sand up to 3/4" thick; brown (CL)									moist very stiff
			10	36							
		grades with occasional to numerous layers up to 2" thick of silty fine sand with some vertical sand layers in clays									
		grades with occasional to numerous layers up to 4" thick of silty fine sand and occasional to some vertical sand layers	15	18							very moist
											saturated
		CLAYEY FINE SAND with dipping bedding approximately 50°; brown/grayish-brown with mottling (SC)									saturated very stiff/medium dense
			20	38							
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3G

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-15-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 18.0' (11-15-10) 12.5' (11-16-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Stopped drilling at 25.0'.									
		Stopped sampling at 26.5'.									
		Installed 1-1/4" diameter slotted PVC pipe to 26.5'.									
			30								
			35								
			40								
			45								
			50								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3G
(con't)

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-15-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 19.0' (11-15-10) 18.8' (11-16-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		4" ASPHALT CONCRETE PAVEMENT									
		CLAYEY FINE TO COARSE SAND, FILL with some fine and coarse gravel; brown (SC-FILL)									moist medium dense
		SILTY FINE SAND dark brown (SM-FILL)									moist loose
		CLAYEY FINE SAND with trace organics; brown (CL))		21							moist loose
		SILTY FINE SAND with trace clay; brown (SM)	5	16							moist loose
		grades light brown	10	13							
		SILTY CLAY with occasional to some near-vertical bedded (80°) layers of silty fine sand up to 1" thick; cemented nodules; brown (CL)									moist medium dense
		grades with occasional to numerous layers up to 4" thick of silty fine sand and occasional to some vertical sand layers	15	52							
		SILTY SAND with occasional layers of silty clay up to 2" thick; dipping bedding approximately 60°; brown (SM)	20	37							saturated medium dense
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3H

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-15-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 19.0' (11-15-10) 18.8' (11-16-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		grades with occasional layers up to 1" thick of silty clay with some fine sand		35							
		Stopped drilling at 25.0'.									
		Stopped sampling at 26.5'.									
		Installed 1-1/4" diameter slotted PVC pipe to 26.5'.	30								
			35								
			40								
			45								
			50								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3H
(con't)

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-15-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 7.0' (11-15-10) Artesian (12-01-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		5.0" ASPHALT CONCRETE									
		SILTY FINE TO COARSE SAND, FILL with some fine gravel; brown (SM/GM-FILL)									moist medium dense
		FINE SANDY CLAY dark brown and brown (CL)		21							moist stiff
		grades silty clay with some fine sand; brown with mottling	5	8		27.7		97			very moist to saturated medium stiff
											saturated
		grades with occasional layers up to 2" thick of silty fine sand; brown	10	21		28.2		97			stiff
		grades with occasional layers up to 3" thick of silty fine sand	15	9		29.4		93			medium stiff
			20	10							
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3I

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-15-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 7.0' (11-15-10) Artesian (12-01-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		grades with occasional to numerous layers up to 1" thick of silty fine sand; grayish-brown		5							stiff
			30	4							
		grades with occasional to numerous layers up to 4" thick of silty fine sand	35	14							
			40	6							
		Stopped drilling at 40.0'. Stopped sampling at 41.5'. Installed 1-1/4" diameter slotted PVC pipe to 41.5'.	45								
			50								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3I
(con't)

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-16-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: No groundwater encountered (11-16-10) 4.8' (12-01-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		4.0" ASPHALT CONCRETE									
		ROADBASE FILL brown (SM/GM-FILL)									moist stiff
		SILTY CLAY with some fine sand; brown (CL)									
			5								
		Stopped drilling at 5.0'.									
		Stopped sampling at 5.0'.									
		No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3J

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-16-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 6.0' (11-16-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		6.5" ASPHALT CONCRETE									
		6.0" ROADBASE FILL brown (SM/GM-FILL)									moist
		SILTY CLAY with some fine sand and occasional layers up to 2" thick of silty fine sand; light brown mottling (CL)									moist
											very stiff
				28		23.6		100			
			5								very moist
				21							saturated
			10								stiff
				12							
			15								medium stiff
				11							
		Stopped drilling at 15.0'.									
		Stopped sampling at 16.5'.	20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3K

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-16-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 7.0' (11-16-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		5.5" ASPHALT CONCRETE									moist
		ROADBASE FILL (SM/GM-FILL)									moist
		SILTY CLAY with some fine sand and occasional to numerous layers up to 2" thick of silty fine sand; brown (CL)									stiff
				19		25.3		98			
			5								
				19							saturated
		grades grayish-brown and brown	10	5							stiff
			15	7							
		Stopped drilling at 14.0'. Stopped sampling at 15.5'.	20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3L

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Campus Housing-Weber State University
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, Ogden, Utah
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-16-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 6.5' (11-16-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		6.0" ASPHALT CONCRETE									
		7.0" ROADBASE FILL									
		SILTY CLAY with some fine sand and occasional layers up to 2" thick of silty fine sand; brown (CL)									moist stiff
				21							
			5								very moist
				13		26.1		96			
	▼										saturated
		SANDY CLAY/CLAYEY SAND with numerous to alternating layers up to 2" thick of some vertical bedding/layering of sand and clay; grayish-brown and brown (CL)									saturated stiff
			10								
				13		28.5		95			
		FINE SANDY CLAY with occasional to some clayey sand layers up to 2" thick; grayish-brown (CL)									saturated medium stiff
			15								
				8							
			20								
				5							
		Stopped drilling at 20.0'.									
		Stopped sampling at 21.5'.									
		Installed 1-1/4" diameter slotted PVC pipe to 21.5'.	25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3M

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Prop. Residential Life Housing Bldg Nos. 2 & 3
Project No.: 0149-015-10
Location: Approx. 4100 S & 1350 E, WSU Campus, Ogden, UT
Client: MHTN Architects, Inc.
Drilling Method: 3-3/4" Hollow-Stem Auger
Date Drilled: 11-16-10
GSH Field Rep.: RJG
Elevation: ---
Water Level: 8.0' (11-16-10) 5.2' (12-01-10)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		5.5" ASPHALT CONCRETE									
		ROADBASE FILL									
		SILTY CLAY with some fine sand and trace organics; brown (CL)									moist stiff
				18							
	▼	grades with cemented nodules; brown with oxidation mottling	5	16		30.3		88			very moist
											saturated
		grades with occasional layers up to 2" thick of silty fine sand; brown	10	19		27.4		96			
		grades grayish-brown	15	12							
			20	4							medium stiff
		Stopped drilling at 20.0'.									
		Stopped sampling at 21.5'.									
		Installed 1-1/4" diameter slotted PVC pipe to 21.5'.	25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3N

UNIFIED SOIL CLASSIFICATION SYSTEM

FIELD IDENTIFICATION PROCEDURES				GRAPH SYMBOL	LETTER SYMBOL [1]	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than half of material is larger than No. 200 sieve size. [2] (The No. 200 sieve size is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size. (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.		GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.		GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
			Plastic fines (for identification procedures see CL below).		GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.
	SANDS More than half of coarse fraction is smaller than No. 4 sieve size. (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size.)	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.		SW	Well graded sands, gravelly sands, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.		SP	Poorly graded sands, gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		SM	Silty sands, poorly graded sand-silt mixtures.
			Plastic fines (for identification procedures see CL below).		SC	Clayey sands, poorly graded sand-clay mixtures.

IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE		DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	GRAPH SYMBOL	LETTER SYMBOL [1]	TYPICAL DESCRIPTIONS
FINE GRAINED SOILS More than half of material is smaller than No. 200 sieve size. (The No. 200 sieve size is about the smallest particle visible to the naked eye)	SILTS AND CLAYS Liquid limit less than 50	None to slight	Quick to slow	None		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sand with slight plasticity.
		Medium to high	None to very slow	Medium		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		Slight to medium	Slow	Slight		OL	Organic silts and organic silt-clays of low plasticity.
	SILTS AND CLAYS Liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		High to very high	None	High		CH	Inorganic clays of high plasticity, fat clays.
		Medium to high	None to very slow	Slight to medium		OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS		Readily identified by color, odor, spongy feel and frequently by fibrous texture.				Pt	Peat and other highly organic soils.

[1] Boundary classifications: –Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW–GC, well graded gravel–sand mixture with clay binder.
[2] All sieve sizes on this chart are U.S. standard.

GENERAL NOTES

1. In general, Unified Soil Classification Designations presented on the logs were evaluated by visual methods only. There rore, actual designations (based on laboratory testing) may differ.

2. Lines seperating strata on the logs represent approximate boundaries only Actual transitions may be gradual.

3. Logs represent general soil conditions observed at teh point of exploration onthe date indicated.

4. No warranty is provided as to the continuity of soil conditions between individual sample locations.

FINE - GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNDRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
Very Soft	<2	<0.125	<0.25	Easily penetrated several inches by Thumb. Squeezes through fingers.
Soft	2 - 4	0.125 - 0.25	0.25 - 0.5	Easily penetrated 1 " by Thumb . Molded by light finger pressure.
Medium Stiff	4 - 8	0.25 - 0.5	0.5 - 1.0	Penetrated over 1/2 " by Thumb with moerate effort. Molded by strong finger pressure.
Stiff	8 - 15	0.5 - 1.0	1.0 - 2.0	Indented about 1/2 " by Thumb but penetrated only with great effort
Very Stiff	15 - 30	1.0 - 2.0	2.0 - 4.0	Readily indented by Thumbnail
Hard	>30	>2.0	>4.0	Indented with difficulty by Thumbnail

LOG KEY SYMBOLS

- Bulk / Bag Sample
- Thin Wall
- Standard Penetration Split Spoon Sampler
- No Recovery
- Rock Core
- 3-3/4" ID D&M Sampler
- 3" ID D&M Sampler
- Water Level
- California Sampler

COARSE -GRAINDE SOIL

APPERENT DENSITY	SPT (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
Very Loose	<4	0 - 15	Easily penetrated with 1/2 " reinforcing rod pushed by hand
Loose	4 - 10	15 - 35	Difficult to penetrated with 1/2 " reinforcing rod pushed by hand
Medium Dense	10 - 30	35 - 65	Easily penetrated a foot with 1/2 " reinforcing rod driven with 5-lb hammer
Dense	30 - 50	65 - 85	Difficult to penetrated a foot with 1/2 " reinforcing rod driven with 5-lb hammer
Very Dense	>50	85 - 100	Penetrated only a few inches with 1/2 " reinforcing rod driven with 5-lb hammer

STRATIFICATION

DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2 "
LAYER	1/2 - 12 "

DESCRIPTION	THICKNESS
Occasional	One or less per foot of thickness
Frequent	More than on per foot of thichness

CEMENTATION

DESCRIPTION	DESCRIPTION
Weakely	Crumbles or breaks with handling of slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumbles or breaks with finger pressure

MODIFIERS

DESCRIPTION	%
Trace	<5
Some	5 - 12
With	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually soil below Water Table

FIGURE 4

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