project manual

camp w.g. williams

144th medical company readiness center

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contract #: 057117
ajc project #: 0470

prepared for:
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volume 1

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144th Medical Company
Readiness Center
Camp W.G. Williams

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SECTION 01100 - 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: 144th Medical Company Readiness Center, Camp W.G. Williams, Riverton, Utah 84065-4999. State of Utah Division of Facilities Construction and Management, Project No. 04042480. Project consists of the construction of a new two story building, including site utility work, utility connections and other site work including grading, asphalt paving and concrete paving. Refer to Construction Documents.

1. Project Location: Camp W.G. Williams, Riverton, Utah.
2. Owner: State of Utah Division of Facilities Construction and Management.

B. Architect Identification: The Contract Documents were prepared for the project by ajc architects, 703 East 1700 South, Salt Lake City, Utah 84105. (801) 466-8818.

C. Project Coordinators:

1. Matthias Mueller, State of Utah Division of Facilities Construction and Management.
2. Scott Potter, Utah National Guard Engineering Division.

D. Project Certification:

1. Project is designed to comply with requirements of Sustainable Design according to the U.S. Army Corps of Engineers (SPiRiT) Sustainable Project Rating Tool, as specified in Division 1 Section "SUSTAINABLE DESIGN REQUIREMENTS" and meet the project goals established by the Owner.

1.3 CONTRACT

A. Project will be constructed under a general construction contract.

1.4 WORK SEQUENCE

A. The Work shall be conducted in one phase.

1.5 USE OF PREMISES

A. General: Contractor shall have limited use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited by

Owner's right to perform work or to retain other contractors on portions of Project, Owner's use of adjacent existing buildings and facilities, and Utah National Guard security restrictions and requirements.

B. Refer to Division 2 Section "Work Restrictions" for site access and security restrictions.

1.6 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-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.

1.7 MISCELLANEOUS PROVISIONS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 The General Contractor shall be responsible to coordinate all aspects of the work with the Owner's Project Manager and coordinate site access with Owner's Security Personnel.

END OF SECTION 01100

SECTION 01140 - WORK RESTRICTIONS

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 USE OF PREMISES

A. Use of Site: Project site is located at Camp W.G. Williams, Riverton, Utah. Site access is limited by Utah National Guard security requirements. 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 constructions operations to areas indicated on Construction Documents.
2. Coordinate with the Owner's Project Manager for staging areas and construction vehicle parking.
3. Use designated truck entrance gate and routes for delivery of heavy and wide loads such as concrete, asphalt, masonry and structural steel.
4. Coordinate with the Owner's Project Manager for any limitations on construction activities or deliveries.
5. Coordinate with the Owner's Project Manager for security issues and access to the construction site, including construction personnel security clearance requirements.
6. Coordinate with the Owner's Project Manager for all required utility shut-downs. Provide utility shut-down requests a minimum of 72 hours prior to the required shut-down time.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01140

SECTION 01210 - EXECUTION 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 general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. General installation of products.
3. Coordination of Owner-installed products.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.
7. Correction of the Work.

1.3 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: 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 underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: 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. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. 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.

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

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation."

3.3 CONSTRUCTION LAYOUT

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

B. Site Improvements: Locate and layout site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

C. 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.

D. 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. 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 before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

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.

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. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

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.

G. 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.

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

3.6 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction forces as may be required.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. 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 materials more than 7 days during normal weather or 3 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.

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: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

I. 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.

J. 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.

K. 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.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.9 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.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."

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 01210

SECTION 01250 - CONTRACT MODIFICATION 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 for handling and processing Contract modifications.

B. Related Sections include the following:

1. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions 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 15 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 AIA Document G709 for Proposal Requests.

D. Proposal Request Form: For Change Order proposals, use DFCM forms provided by Owner.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on DFCM Change Order form.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714 Construction 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 01250

SECTION 01290 - 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. Architect's project number.
    d. Contractor's name and address.
    e. 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. Include evidence of insurance or bonded warehousing if required.

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: 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 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. 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 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt. 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.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

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.

H. 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.
6. Submittals Schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. Data needed to acquire Owner's insurance.
16. Initial settlement survey and damage report if required.

I. 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.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. 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 meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01290

SECTION 01310 - 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. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

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

1. Division 1 Section "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
2. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements" for Owner's SPiRIT requirements.
4. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

A. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, 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. Project closeout activities.

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. Indicate required installation sequences.
3. Refer to Division 15 Section "Basic Mechanical Materials and Methods" and Division 16 Section "Basic Electrical Materials and Methods" for specific Coordination Drawing requirements for mechanical and electrical installations.

B. Staff Names: Within 15 days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; 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 other contractors.

1.6 PROJECT MEETINGS

A. General: The Owner shall 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, 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: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 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. Hold the conference at Project site or another convenient location. 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. Progress cleaning.
r. Working hours.

C. Progress Meetings: Conduct progress meetings at regular intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, 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.

3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

   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 01310

SECTION 01320 - 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. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Material location reports.
6. Field condition reports.
7. Special reports.
8. Construction photographs.

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 Sections "Construction Waste Management" and "Sustainable Design Requirements" for Owner's SPiRiT documentation requirements.
6. Division 1 Section "Closeout Procedures" for submitting photographic negatives as Project Record Documents at Project closeout.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor activity is an activity that must be completed before a given activity can be started.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

G. Major Area: A story of construction, a separate building, or a similar significant construction element.

H. Milestone: A key or critical point in time for reference or measurement.

I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.4 SUBMITTALS

A. 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.

B. Submittals Schedule: Submit three copies of schedule. 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 final release or approval.

C. Preliminary Construction Schedule: Submit two printed copies; one a single sheet of reproducible media, and one a print.

D. Contractor's Construction Schedule: Submit two printed copies of initial schedule, one a reproducible print and one a blue- or black-line print, large enough to show entire schedule for entire construction period.

E. CPM Reports: Concurrent with CPM schedule, submit three printed copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.

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

1. Format: Digitally.

G. Daily Construction Reports: Submit two copies at monthly intervals.

H. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting.

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

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 from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

C. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities including temporary lighting.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. 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.

2.2 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 the Notice to Proceed to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

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. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. 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.
4. Startup and Testing Time: Include not less than 1 day for startup and testing.
5. 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.

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 by Owner: Include a separate activity for each portion of the Work performed by Owner.
2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Work Restrictions: Show the effect of the following items on the schedule:

a. Coordination with existing construction.
b. Limitations of continued occupancies.
c. Uninterruptible services.

d. Partial occupancy before Substantial Completion.
e. Use of premises restrictions.
f. Provisions for future construction.
g. Seasonal variations.
h. Environmental control.

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

a. Subcontract awards.
b. Submittals.
c. Purchases.
d. Mockups.
e. Fabrication.
f. Sample testing.
g. Deliveries.
h. Installation.
i. Tests and inspections.
j. Adjusting.
k. Curing.
l. 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, and Final Completion.

F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.

1. Refer to Division 1 Section "Payment Procedures" for cost reporting and payment procedures.

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

H. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established the Notice to Proceed. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.5 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.
2. List of separate contractors at Project site.
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. Meter readings and similar recordings.
10. Emergency procedures.
11. Orders and requests of authorities having jurisdiction.
12. Change Orders received and implemented.
13. Construction Change Directives received.
14. Services connected and disconnected.
15. Equipment or system tests and startups.
16. Partial Completions and occupancies.
17. Substantial Completions authorized.
18. Construction Waste Management

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.

2.6 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.

C. Construction Waste Management reports as outlined in Division 1 Section "Construction Waste Management".

D. All required SPiRiT documentation as outlined in Division 1 Section "Sustainable Design".

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week 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, separate contractors, testing and inspecting agencies, 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.

3.2 CONSTRUCTION PHOTOGRAPHS

A. Periodic Construction Photographs: Take four to six digital photographs weekly, coinciding with cutoff date associated with each Application for Payment. Photographer shall select vantage points to best show status of construction and progress since last photographs were taken.

END OF SECTION 01320

SECTION 01330 - 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 for submitting Shop Drawings, Product Data, Samples, and other miscellaneous 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.

1.4 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.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

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. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

D. 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 15 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 21 days for initial review of each submittal.

3. If intermediate submittal is necessary, process it in same manner as initial submittal.
4. Allow 15 days for processing each resubmittal.
5. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

E. 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 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.
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.

F. Deviations: 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.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
2. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.

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 Contractor.

1. On an attached separate sheet, 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. Number of Copies: Submit four copies of each submittal, unless otherwise indicated. Architect, will return two copies. Mark up and retain one returned copy as a Project Record Document.
2. Number of Copies: Submit copies of each submittal, as follows, unless otherwise indicated:

a. Initial Submittal: Submit a preliminary single copy of each submittal where selection of options, color, pattern, texture, or similar characteristics is required. Architect will return submittal with options selected.
b. Final Submittal: Submit three copies, unless copies are required for operation and maintenance manuals. Submit five copies where copies are required for operation and maintenance manuals. Architect will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Document.

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 copy of 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.
e. Manufacturer's catalog cuts.

f. Wiring diagrams showing factory-installed wiring.
g. Printed performance curves.
h. Operational range diagrams.
i. Mill reports.
j. Standard product operating and maintenance manuals.
k. Compliance with recognized trade association standards.
l. Compliance with recognized testing agency standards.
m. Application of testing agency labels and seals.
n. 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 but no larger than 30 by 40 inches.
4. Number of Copies: Submit one correctable, translucent, reproducible print and one blue- or black-line print of each submittal. Architect will return the reproducible print.
5. Number of Copies: Submit three blue- or black-line prints of each submittal, unless prints are required for operation and maintenance manuals. Submit five prints where prints are required for operation and maintenance manuals. Architect will retain two prints; remainder will be returned. Mark up and retain one returned print as a Project Record Drawing.
6. Number of Copies: Submit copies of each submittal, as follows:
   a. Final Submittal: Submit three blue- or black-line prints, unless prints are required for operation and maintenance manuals. Submit five prints where prints are required for operation and maintenance manuals. Architect will retain two prints; remainder will be returned. Mark up and retain one returned print as a Project Record Drawing.

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 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.

3. 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.

4. 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.

5. 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.
6. Number of Samples for Verification: Submit three sets of Samples. Architect will retain two. Sample sets; remainder will be returned.

    a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

F. Product Schedule or List: Prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.
2. Number and name of room or space.
3. Location within room or space.

G. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."

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

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

J. 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.

K. SPiRiT Submittals: Comply with requirements specified in Division 1 Section "Sustainable Design Requirements".

1. Number of Copies: Submit five copies of SPiRiT submittals, unless otherwise indicated.

L. Material Safety Data Sheets (MSDSs) for SPiRiT Certification: Submit information necessary to show compliance with SPiRiT certification requirements, which will be the limit of the Architect's review.

1. Architect will not review non-SPiRiT submittals that include MSDSs and will return the entire submittal for resubmittal.

2.2 INFORMATIONAL SUBMITTALS

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

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. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

L. 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.

M. 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.

N. 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.

O. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment.

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. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.

7. Other required items indicated in individual Specification Sections.

R. 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.

S. 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.

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

END OF SECTION 01330

SECTION 01400 - 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. 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-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 Contract 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. Related Sections include the following:

1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
2. Division 1 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
3. Divisions 2 through 16 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 substantiate that proposed construction will comply with requirements.

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

C. Mockups: Full-size, physical assemblies that are constructed on-site. 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. Approved mockups establish the standard by which the Work will be judged.

D. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

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

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

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.

J. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

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 Architect 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 Architect for a decision before proceeding.

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. Schedule of Tests and Inspections: 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.

C. 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. Record of temperature and weather 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.

D. 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. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. 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.

C. 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, as well as sufficient production capacity to produce required units.

D. 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.

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. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. 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.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products 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.

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 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. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

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 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. 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 as specified in Division 1 Section "Submittal Procedures."

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

E. 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. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. 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.

G. Coordination: Coordinate sequence of 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.

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

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for the Notice to Proceed.

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.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

B. Special Tests and Inspections: Conducted by a qualified special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.

2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 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 Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
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 01400

SECTION 01500 - 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. Support facilities include, but are not limited to, the following:

1. Waste disposal facilities, refer to Division 1 Section "Construction Waste Management" for additional disposal facilities requirements.
2. Field offices.

C. Security and protection facilities include, but are not limited to, the following:

1. Security enclosure and lockup.
2. Barricades, warning signs, and lights.
3. Environmental Protection requirements.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 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.

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.

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. Heating Equipment: Unless Owner authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.

E. 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.

F. 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. 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 a portable cellular telephone for superintendent's use in making and receiving telephone calls when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Locate field offices, sanitary facilities, and other temporary construction and support facilities for easy access.
2. Provide incombustible construction for offices 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. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.

C. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.

1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.
2. Develop a waste management plan for Work performed on Project. Indicate types of waste materials Project will produce and estimate quantities of each type. Provide detailed information for on-site waste storage and separation of recyclable materials. Provide information on destination of each type of waste material and means to be used to dispose of all waste materials.
3. Comply with requirements of Division 1 Section "Construction Waste Management".

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 and meetings of 10 persons at Project site. Keep office clean and orderly.

1. Furnish and equip offices as follows:

a. Desk and four chairs, four-drawer file cabinet, a plan table, a plan rack, and bookcase.
b. Water cooler and private toilet complete with water closet, lavatory, and medicine cabinet with mirror.
c. Provide a room of not less than 240 sq. ft. (22.5 sq. m) for Project meetings. Furnish room with conference table, 12 folding chairs, and 4-foot- (1.2-m-) square tack board.

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. Refer to Civil Engineering Drawings and Specification for requirements of providing an Environmental Protection Plan prior to the start of construction.

B. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

C. 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.

END OF SECTION 01500

SECTION 01630 - 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 administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:

1. Division 1 Section "References" for applicable industry standards for products specified.
2. Division 1 Section "Sustainable Design Requirements" for SPiRiT product requirements.
3. Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.
4. Divisions 2 through 16 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, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

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

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," 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.

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 15 days after date of commencement of the Work, submit 3 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 30 days after date of commencement of the Work, submit 3 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 10 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 to comply with the Contract Documents.

B. Substitution Requests: Submit three copies of each request for consideration. All substitutions must be submitted during the bid period per the Instructions to Bidders. 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 or form provided by Owner or architect.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified material or product cannot be provided.
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. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. 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 lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. 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. Architect will notify Contractor of acceptance or rejection of proposed substitution within bid period and receipt of additional information or documentation, whichever is later.

a. Form of Acceptance: Addendum.
b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

C. Comparable Product 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.

a. Form of Approval: Addendum.
b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.

D. 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.

B. Delivery and Handling:

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.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. 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.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. 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.

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. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. 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 SELECTION PROCEDURES

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 Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements, within compliance with procurement laws and ordinances of the jurisdiction.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements, within compliance with procurement laws and ordinances of the jurisdiction.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.

7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide 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 Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product 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, density, 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, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. 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:

1. 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.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.

10. 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.

2.3 COMPARABLE PRODUCTS

A. Conditions: Architect will consider Contractor's request for comparable product 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:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01600

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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September 1996
CSI Form 13.1A

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 01731 - CUTTING AND PATCHING

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 procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 15 and 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

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

1.4 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.

6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. 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.

C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces 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.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during 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 of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing 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.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

A. 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 existing 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. Cutting: Cut existing 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 as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
5. 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.
6. Proceed with patching after construction operations requiring cutting are complete.

C. 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 possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate 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 eliminate evidence of patching and refinishing.
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 existing 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, apply primer and intermediate paint coats 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. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 01731

SECTION 01741 - 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 Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.

B. Related Sections include the following:

1. Division 01 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 01 Section "Temporary Facilities and Controls" for environmental-protection measures during construction.
3. Division 02 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.
4. Division 04 Section "Unit Masonry" for disposal requirements for masonry waste.

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 GOALS

A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of 50 percent by weight of total waste generated by the Work.

B. Salvage/Recycle **Goals**: Owner's goal is to salvage and recycle as much nonhazardous demolition, site clearing and construction waste as possible. Owner has established minimum goals for the following materials:

1. Demolition Waste:

a. Asphaltic concrete paving.
b. Concrete.
c. Concrete reinforcing steel.
d. Piping.
e. Valves.
f. Electrical conduit.
g. Copper wiring.

2. Construction Waste:

a. Site-clearing waste.
b. Masonry and CMU.
c. Lumber.
d. Wood sheet materials.
e. Wood trim.
f. Metals.
g. Roofing.
h. Insulation.
i. Carpet.
j. Gypsum board.
k. Piping.
l. Electrical conduit.
m. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

1) Paper.
2) Cardboard.
3) Boxes.
4) Plastic sheet and film.
5) Polystyrene packaging.
6) Wood crates.
7) Plastic pails.

1.5 SUBMITTALS

A. Waste Management Plan: Submit 3 copies of plan within 30 days of date established for the Notice to Proceed.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit three copies of report. Include separate reports for demolition and construction 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.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit three copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

F. 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.

G. 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.

• H. SPiRiT Submittal: SPiRiT letter template for Credit MR 4.C2, 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.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. 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.
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.

1.7 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Include separate sections in plan for 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, site-clearing and construction waste generated by the Work. 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. 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 Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
2. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
4. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
5. 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. 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 waste management plan as approved by Architect and Owner. 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. 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. Review plan procedures and locations established for salvage, recycling, and disposal.

C. 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 Sale and Donation: Not permitted on Project site.

3.3 RECYCLING DEMOLITION, SITE CLEARING 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, unless otherwise indicated or allowed by the Government.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

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. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

C. Metals: Separate metals by type.

D. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

E. 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. Site-Clearing Wastes: Chip brush, branches, and trees on-site or at landfill facility.

C. 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.

D. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.

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 acceptable waste materials and dispose of at designated spoil areas on Owner's property.

D. Disposal: Transport non-acceptable waste materials off Owner's property and legally dispose of them.

END OF SECTION 01741

SECTION 01770 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Project Record Documents.
3. Operation and maintenance manuals.
4. Warranties.
5. Instruction of Owner's personnel.
6. Final cleaning.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 1 Section "Construction Progress Documentation" for submitting Final Completion construction photographs and negatives.
3. Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements" for all documentation requirements.
4. Division 1 Section "Project Record Documents" for specific record document requirements.
5. Division 1 Section "Operation and Maintenance Data" for additional Project Closeout requirements.
6. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for products of 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 in 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. Refer to Section "Operation and Maintenance Data for submittal requirements.

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, operation and maintenance manuals, Final Completion construction photographs damage or settlement surveys, property surveys, and similar final record information. Refer to Section "Operation and Maintenance Data for submittal requirements.
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. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. 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 date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1 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. Submit pest-control final inspection report and warranty.
5. 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. Preparation: Submit three copies 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.

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.

1.6 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of blue - or black-line white prints of Contract Drawings and Shop Drawings.

1. 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 prepare the marked-up Record Prints.

a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
b. Accurately record information in an understandable drawing technique.
c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
3. Mark important additional information that was either shown schematically or omitted from original Drawings.

4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
6. Architect will provide corrected Record Drawings in electronic media format.

C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy 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. Note related Change Orders, Record Drawings, where applicable.
4. Architect will provide corrected Record Specifications in electronic media format.

D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

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 Drawings, and Record Specifications, where applicable.

E. Miscellaneous Record Submittals: 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.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Assemble four complete sets of operation and maintenance data, and one set of electronic media in PDF format on CD-R, indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Operation Data:

   a. Emergency instructions and procedures.
   b. System, subsystem, and equipment descriptions, including operating standards.
   c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
   d. Description of controls and sequence of operations.
   e. Piping diagrams.

2. Maintenance Data:

a. Manufacturer's information, including list of spare parts.
b. Name, address, and telephone number of Installer or supplier.
c. Maintenance procedures.
d. Maintenance and service schedules for preventive and routine maintenance.
e. Maintenance record forms.
f. Sources of spare parts and maintenance materials.
g. Copies of maintenance service agreements.
h. Copies of warranties and bonds.

B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.8 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, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (115-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. Provide one set of warranties on electronic media in PDF format on CD-R

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.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide 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, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
j. 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.
k. Remove labels that are not permanent.
l. 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 similar labels, including mechanical and electrical nameplates.

m. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to unusual operating conditions.

o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
q. Clean ducts, blowers, and coils if units were operated without filters during construction.
r. 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.
s. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770

SECTION 01781 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Electronic media submittal requirements on CD-R.

B. Related Sections include the following:

1. Division 1 Section "Closeout Procedures" for general closeout procedures.
2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements".
4. Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up Record Prints.
2. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal: Submit one set of corrected Record Transparencies and one set of marked-up Record Prints. Architect will initial and date each transparency and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. Architect will return transparencies and prints for organizing into sets, printing, binding, and final submittal.

b. Final Submittal: Submit one set of marked-up Record transparencies, one set of marked-up Record Prints, one set of Architect's Record CAD Drawing files, one set of Architect's Record CAD Drawing original plots, and three copies printed from record plots. Plot and print each Drawing, whether or not changes and additional information were recorded.

1) Electronic Media: CD-R.

B. Record Specifications: Submit two copies of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one copy of each Product Data submittal.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints 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 prepare the 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 understandable drawing technique.
c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

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 and clarifications.
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.
o. Contractor's Coordination Drawings.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
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 Transparencies: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect. When authorized, prepare a full set of corrected transparencies of the Contract Drawings and Shop Drawings.

1. Incorporate changes and additional information previously marked on Record Prints. Erase, redraw, and add details and notations where applicable.
2. Refer instances of uncertainty to Architect for resolution.
3. Owner will furnish Contractor one set of transparencies of the Contract Drawings for use in recording information.
4. Print the Contract Drawings and Shop Drawings for use as Record Transparencies. Architect will make the Contract Drawings available to Contractor's print shop.

C. Record CAD Drawings: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect for coordinating Architect's CAD Record Drawing preparation.

D. 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.

E. 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. Record Transparencies: Organize into unbound sets matching Record Prints. Place transparencies in durable tube-type drawing containers with end caps. Mark end cap of each container with identification. If container does not include a complete set, identify Drawings included.
3. Record CAD Drawings: Organize CAD 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 CAD 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.

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.

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.

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 01781

SECTION 01782 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This 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. Maintenance manuals for the care and maintenance of products, materials, and finishes, systems and equipment.
5. Electronic media submittal requirements in PDF format on CD-R.

B. Related Sections include the following:

1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
4. Divisions 2 through 16 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 SUBMITTALS

A. Initial Submittal: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return one copy of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.

1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

2. Final submittal to include 1 copy of electronic media in PDF format on CD-R.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

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 MANUALS, GENERAL

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: Enclose title page in transparent plastic sleeve. 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, address, and telephone number of Contractor.
6. Name and address of Architect.
7. 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.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf 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. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. 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 diskettes 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.
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.

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 MANUAL

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.

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 MANUAL

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.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed 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 videotape, 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. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. 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.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. 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.

E. 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.

F. 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 1 Section "Project Record Documents."

G. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

H. Final electronic media submittal of Operation and Maintenance in PDF format to be issued on CD-R discs.

END OF SECTION 01782

SECTION 01811 - 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. This Section includes general requirements and procedures for compliance with certain U.S. Army Corps of Engineers (SPiRiT) Sustainable Project Rating Tool prerequisites and credits for the Project to obtain SPIRIT certification points as indicated.

1. Other SPiRiT prerequisites and credits needed to obtain SPiRiT credits are dependent on material selections and may not be specifically identified as SPiRIT requirements. Compliance with requirements needed to obtain SPiRiT prerequisites and credits may be used as one criterion to evaluate substitution requests.
2. Additional SPiRiT prerequisites and credits needed to obtain the indicated SPiRiT credits are dependent on the Architect's design and other aspects of the Project that are not part of the Work of the Contract.

B. Related Sections include the following:

1. Divisions 01 through 16 Sections for Sustainable Design "SPiRiT" requirements specific to the Work of each of those Sections. These requirements may or may not include reference to SPiRiT.

1.3 DEFINITIONS

A. Certificates of Chain-of-Custody: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria." Certificates shall include evidence that mill is certified for chain-of-custody by an FSC-accredited certification body.

B. SPiRiT: Sustainable Project Rating Tool.

C. Rapidly Renewable Materials: Materials made from agricultural products that are typically harvested within a ten-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.

D. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles (800 km) from the Project location. Manufacturing refers to the final assembly of components into the building product that is installed at the Project site.

E. Regionally Extracted, Harvested, or Recovered Materials: Materials that are extracted, harvested, or recovered and manufactured within a radius of 500 miles (800 km) from the Project site.

F. 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 SPiRiT submittal requirements included in other sections of the Specifications.

B. SPiRiT 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 SPiRiT requirements.

C. Project Materials Cost Data: Provide statement indicating total cost for building materials used for Project. Include statement indicating total cost of mechanical and electrical components.

D. SPiRiT 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 SS 1.R1: Erosion, Sedimentation, and Water Quality Control plan, complying with Division 02 requirements.
2. Credit MR 4.C2: Waste management plan complying with Division 01 Section "Construction Waste Management and Disposal."
3. Credit MR 4.C4: List of proposed materials with recycled content.

    a. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.

4. Credit MR 4.C5: List of proposed regionally manufactured materials.

    a. Identify each regionally manufactured material, its source, and cost.

5. Credit IEQ 5.C1: Construction indoor air quality management plan.

E. SPiRiT Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with SPiRiT action plans for the following:

1. Credit MR 4.C2: Waste reduction progress reports complying with Division 01 Section "Construction Waste Management and Disposal."
2. Credit MR 4.C4: Recycled content.
3. Credit MR 4.C5: Regionally manufactured materials[.

F. SPiRit Documentation Submittals:

1. Credit SS 1.C7: Product Data for roofing materials indicating Energy Star compliance and low emissive roofing compliance.
2. Credit MR 4.C2: Comply with Division 01 Section "Construction Waste Management and Disposal."
3. Credit MR 4.C4: 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 costs for each product having recycled content.
4. Credit MR 4.C5: Product Data indicating location of material manufacturer for regionally manufactured materials.

    a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.

5. Credit IEQ 5.C1: Product Data and Shop Drawings for carbon dioxide monitoring system.
6. Credit IEQ 5.C4: Product Data for adhesives and sealants used on the interior of the building indicating VOC content of each product used. Indicate VOC content in g/L calculated according to SCAQM & Bay Area AQMD methods.
7. Credit IEQ 5.C4: Product Data for paints and coatings used on the interior of the building indicating chemical composition and VOC content of each product used. Indicate VOC content in g/L calculated according to Green Seal.
8. Credit IEQ 5.C4: Product Data for carpet products indicating VOC content of each product used based on Carpet and Rug Institute "Green Label IAQ test program.
9. Credit IEQ 5.C4: Product Data for composite wood and agrifiber products indicating that products contain no urea-formaldehyde resin.

    a. Include statement indicating adhesives and binders used for each product.

10. Credit EQ 6.2: Product Data and Shop Drawings for sensors and control system used to provide individual airflow and temperature controls for minimum 50 percent of non-perimeter, regularly occupied space.

PART 2 - PRODUCTS

2.1 RECYCLED CONTENT OF MATERIALS

A. Credit MR 4.C4: Provide building materials with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of twentyfive percent of the cost of materials used for the Project.

1. The cost of post-consumer recycled content of an item shall be determined by dividing the weight of post-consumer recycled content in the item by the total weight of the item and multiplying by the cost of the item.
2. The cost of post consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing the weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by the total weight of the item and multiplying by the cost of the item.
3. Do not include mechanical and electrical components in the calculation.

4. Recycled content of materials shall be defined according to the Federal Trade Commission's "Guide for the Use of Environmental Marketing Claims," 16 CFR 260.7 (e).

2.2 REGIONAL MATERIALS

A. Credit MR 4.C5: Provide 20 percent of building materials (by cost) that are regionally manufactured materials within a radius of 500 miles.

2.3 CERTIFIED WOOD

2.4 LOW-EMITTING MATERIALS

A. Credit IEQ 5.C4: For interior applications use adhesives and sealants that comply with the following limits for VOC content when calculated according to SCAQM and Bay Area AQMD and VOC limits for carpet systems based on Carpet and Rug Institute "Green Label IAQ test program":

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. Structural Glazing Adhesives: 100 g/L.
16. Wood Flooring Adhesive: 100 g/L.
17. Contact Adhesive: 250 g/L.
18. Plastic Cement Welding Compounds: 350 g/L.
19. ABS Welding Compounds: 400 g/L.
20. CPVC Welding Compounds: 490 g/L.
21. PVC Welding Compounds: 510 g/L.
22. Adhesive Primer for Plastic: 650 g/L.
23. Sealants: 250 g/L.
24. Sealant Primers for Nonporous Substrates: 250 g/L.
25. Sealant Primers for Porous Substrates: 775 g/L.

B. Credit IEQ 5.C4: For interior applications use paints and coatings that comply with the following limits for VOC content when calculated according to Green Seal and the following chemical restrictions:

1. Flat Paints and Coatings: VOC not more than 50 g/L.
2. Non-Flat Paints and Coatings: VOC not more than 150 g/L.
3. Anti-Corrosive Coatings: VOC not more than 250 g/L.

4. Varnishes and Sanding Sealers: VOC not more than 350 g/L.
5. Stains: VOC not more than 250 g/L.
6. 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).
7. 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 IEQ 5.C4: Do not use composite wood and agrifiber products that contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. Credit MR 4.C2: Comply with Division 01 Section "Construction Waste Management and Disposal."

END OF SECTION 018113

SECTION 01820 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This 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.

B. Related Sections include the following:

1. Division 1 Section "Project Management and Coordination" for requirements for preinstruction conferences.
2. Divisions 2 through 16 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including 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. At completion of training, submit one complete training manual(s) for Owner's use.

B. Qualification Data: For instructor.

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. Transcript: Prepared on 8-1/2-by-11-inch (215-by-280-mm) paper, punched and bound in heavy-duty, 3-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 videotape. Include name of Project and date of videotape on each page.

1.4 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 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 1 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.

1.5 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 equipment not part of a system, as required by individual Specification Sections, and as follows for installed items:

1. Motorized doors, including overhead coiling doors.
2. Fire-protection systems, including fire alarm, fire pumps, and fire-extinguishing systems.
3. HVAC systems, including air-handling equipment, air distribution systems, and terminal equipment and devices.
4. HVAC instrumentation and controls.
5. Electrical service and distribution, including transformers, switchboards, panelboards, uninterruptible power supplies, and motor controls.
6. Lighting equipment and controls.

7. Communication systems, including intercommunication, surveillance, clocks and programming, voice and data and television equipment.

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:

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 combined training manual.

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 Architect, with at least seven 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 remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01820

SECTION 02230 - SITE CLEARING

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. Protecting existing trees and vegetation to remain.
2. Removing trees and other vegetation.
3. Clearing and grubbing.
4. Topsoil stripping.
5. Removing above-grade site improvements.
6. Disconnecting, capping or sealing, and abandoning site utilities in place.
7. Disconnecting, capping or sealing, and removing site utilities.

B. Related Sections include the following:

1. Division 1 Section "Field Engineering" for verifying utility locations and for recording field measurements.
2. Division 1 Section "Construction Facilities and Temporary Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures during site operations.
3. Division 2 Section "Building Demolition" for demolition of buildings, structures, and site improvements.
4. Division 2 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

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 weeds, roots, and other deleterious materials.

1.4 MATERIALS OWNERSHIP

A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the 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 1 Section "Contract Closeout."

1. Identify and accurately locate utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

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. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Contractor shall notify authority having jurisdiction for location of utilities and Blue Stakes for other utilities.

D. Contractor shall clear access areas to site for execution of the work as part of the bid.

E. Contractor shall require operators of trucks which haul dirt from one site to another via city streets to clean the truck tires before leaving the construction site to assure that dirt and debris does not fall on city streets during transit.

PART 2 – PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 2 Section "Earthwork."

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. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Locate and clearly flag trees and vegetation to remain or to be relocated.

D. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.

2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.

B. Do not excavate within drip line of trees, unless otherwise indicated.

C. Where excavation for new construction is required within drip line of trees, 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 relocated and covered with soil.

3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.

4. Cover exposed roots with wet burlap to prevent roots from drying out. 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 a qualified 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 the qualified arborist.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Owner will arrange to shut off indicated utilities when requested by Contractor.

2. Arrange to shut off indicated utilities with utility companies.

B. 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.

C. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.

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. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.

4. Use only hand methods for grubbing within drip line of remaining trees.

5. On-site burning is not permitted.

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 8-inch loose depth, and compact each layer to a density equal to adjacent original ground.

3.5 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. Strip surface soil of unsuitable 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. Contractor to coordinate the location of topsoil stockpiles with Architect.

1. Limit height of topsoil stockpiles to 72 inches.

2. Do not stockpile topsoil within drip line of remaining trees.

3. Dispose of excess topsoil as specified for waste material disposal.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

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.

3.7 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.

END OF SECTION

SECTION 02411 - SELECTIVE DEMOLITION

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 the following:

1. Demolition and removal of selected site elements.
2. Salvage of existing items to be reused or recycled.

B. Related Sections include the following:

1. Division 01 Section "Summary" for use of premises and Owner-occupancy requirements.
2. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
3. Division 01 Section "Cutting and Patching" for cutting and patching procedures.
4. Division 01 Section "Construction Waste Management and Disposal" for disposal of demolished materials.
5. Division 02 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's adjacent operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.

3. Coordination for shutoff, capping, and continuation of utility services.
4. Locations of proposed dust- and noise-control temporary partitions and means of egress.
5. Coordination of Owner's continuing occupancy of portions of existing adjacent buildings and sites.
6. Means of protection for items to remain and items in path of waste removal from building.

B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

C. Predemolition Photographs or Videotapes, as required: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 Section "Photographic Documentation." Submit before Work begins.

D. Landfill Records, where applicable: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1. Comply with submittal requirements in Division 01 Section "Construction Waste Management and Disposal."

1.5 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective 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 selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
3. Review areas where existing construction is to remain and requires protection.

1.6 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

1. Comply with requirements specified in Division 01 Section "Summary."

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

    a. Existing buildings and structures as indicated.

C. Notify Architect and Owner's Project Manager of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, or preconstruction videotapes.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner's Project Manager will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Comply with requirements for dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Maintain adequate ventilation when using cutting torches.
2. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
3. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal."

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain, using power-driven saw. Dislodge concrete from

reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

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.
3. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport acceptable demolished materials and dispose of at designated spoil areas on Owner's property.

D. Disposal: Transport unacceptable demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02411

SECTION 02240 - DEWATERING

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 construction dewatering.

B. Related Sections include the following:

1. Division 1 Section "Temporary Facilities and Controls" for temporary utilities and support facilities.

2. Division 2 Section "Excavation Support and Protection."

3. Division 2 Section "Earthwork" for excavating, backfilling, site grading and for site utilities.

4. Division 2 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 ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.

1. 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.

2. Prevent surface water from entering excavations by grading, dikes, or other means.

3. Accomplish dewatering without damaging existing buildings adjacent to excavation.

4. Remove dewatering system if no longer needed.

1.4 SUBMITTALS

A. Shop Drawings for Information: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of headers and discharge lines; and means of discharge and disposal of water. Any dewatering system design shall be reviewed and approved by Architect.

1. Dewatering systems should be of the gravity underground type, but may be pumped or flow overland with approval from Architect.

2. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.

3. Include a written report outlining control procedures to be adopted if dewatering problems arise.

4. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.

B. Qualification Data: For Installer and professional engineer.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

D. Record drawings at Project closeout identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions performed during dewatering.

1. Note locations and capping depth of wells and well points.

E. Field Test Reports: Before starting excavation, submit test results and computations demonstrating that dewatering system is capable of meeting performance requirements.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 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.

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 included elsewhere in the Project Manual.

C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor, 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.

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.

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. The system is not to be shut off until Architect approval has been received.

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 free water level below bottom of excavation during construction.

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 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.

END OF SECTION

SECTION 02300 - EARTHWORK

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. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches within building lines.
8. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:

1. Division 1 Section "Unit Prices" for a schedule of unit prices.
2. Division 1 Section "Construction Facilities and Temporary Controls."
3. Division 2 Section "Site Clearing" for site stripping, grubbing, removing topsoil, and protecting trees to remain.
4. Division 2 Section "Dewatering" for lowering and disposing of ground water during construction.
5. Division 2 Section "Excavation Support and Protection."
6. Division 2 Section "Subdrainage" for drainage of footings, slabs-on-grade, and walls.
7. Division 3 Section "Cast-in-Place Concrete" for granular course over vapor retarder.
8. Division 15 and 16 Sections for excavating and backfilling buried mechanical and electrical utilities and buried utility structures.

1.3 UNIT PRICES

A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:

1. 24 inches outside of concrete forms other than at footings.

2. 12 inches outside of concrete forms at footings.

3. 6 inches outside of minimum required dimensions of concrete cast against grade.

4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.

5. 6 inches beneath bottom of concrete slabs on grade.

6. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

B. Unit prices for rock excavation include replacement with approved materials.

1.4 DEFINITIONS

A. Backfill: Soil materials 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: Layer placed between the subbase course and asphalt paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations.

1. Additional Excavation: Excavation below subgrade elevations as directed by Architect. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated 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, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cu. yd. for bulk excavation or 3/4 cu. yd. 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, short-tip-radius rock bucket; rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 lbf and stick-crowd force of not less than 18,700 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 45,000-lbf breakout force; measured according to SAE J-732.

I. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material 3/4 cu. yd. or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows/2 inches.

J. 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.

K. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

L. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

M. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.

2. Drainage fabric.

3. Separation fabric.

B. Samples: For the following:

1. 30-lb samples, sealed in airtight containers, of each proposed soil material from on-site or borrow sources.

2. 12-by-12-inch sample of drainage fabric.

3. 12-by-12-inch sample of separation fabric.

1.6 QUALITY ASSURANCE

A. 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.

B. Preexcavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.7 PROJECT CONDITIONS

A. Contractor shall notify Architect before commencement of any excavation.

B. 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. Contractor shall notify public utility companies when excavation is close to their lines before excavation.

2. Notify Architect not less than two days in advance of proposed utility interruptions.

3. Do not proceed with utility interruptions without Architect's written permission.

4. Contractor shall notify public utility companies when excavation is close to their utility lines before excavation.

5. Contact utility-locator service for area where Project is located before excavating.

C. 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 a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials per Architect.

E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2- inch sieve and not more than 12 percent passing a No. 200 sieve.

F. Base: 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 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

G. 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 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

H. Bedding: 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 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

I. Drainage Fill: Washed, narrowly graded mixture of 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.

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. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of 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:

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.

B. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 110 lbf; ASTM D 4632.

2. Tear Strength: 40 lbf; ASTM D 4533.

3. Puncture Resistance: 50 lbf; ASTM D 4833.

4. Water Flow Rate: 150 gpm per sq. ft.; ASTM D 4491.

5. Apparent Opening Size: No. 50; ASTM D 4751.

C. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 200 lbf; ASTM D 4632.

2. Tear Strength: 75 lbf; ASTM D 4533.

3. Puncture Resistance: 90 lbf; ASTM D 4833.

4. Water Flow Rate: 4 gpm per sq. ft.; ASTM D 4491.

5. Apparent Opening Size: No. 30; ASTM D 4751.

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. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. 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.

D. Contractor shall preserve and protect existing bench marks, structures, fences, roads, sidewalks, utilities, trees, shrubs, lawns, paving and curbs that are not marked to demolish. Contractor shall repair any damage his work causes.

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: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Classified Excavation: Excavation to subgrade elevations classified as earth and rock. Rock excavation will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock.

a. Contractor shall notify Architect immediately when unexpected rock removal is required.

b. Do not excavate rock until it has been classified and cross-sectioned by Architect.

c. Where rock is encountered, contractor shall cut away rock at excavation bottom to form a level bearing.

3. Contractor shall inform Architect upon discovery of unknown utilities or concealed conditions.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. 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. 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 for bearing surface.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

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 a working 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 on 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 and 24 inches wider than the outside bell diameter elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 APPROVAL OF SUBGRADE

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.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect.

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 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 materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Contractor shall coordinate with Architect for temporary storage site of excavated soil identified for use as backfill.

2. 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, dampproofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for record documents.

3. Inspecting and testing 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.

3.12 UTILITY TRENCH BACKFILL

A. 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.

B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 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.

D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

G. Place and compact final backfill of satisfactory soil material to final subgrade.

H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 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.

3.14 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill 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 BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 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.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, walkways, building slabs, steps, and pavements, compact each layer of backfill or fill material at 96 percent, 8-inch layers.

2. Under lawn or unpaved areas, compact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 percent, 12-inch layers.

3. Where specific compaction recommendations are included in the soils report for the project, the soils report recommendations shall be followed in lieu of the above stated standards.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free from 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.

3. Slopes steeper than 3H:1V are only to be used when no other option is available and only with prior approval from Architect.

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 1/2 inch.

2. Walks: Plus or minus 1/8 inch.

3. Pavements: Plus or minus 1/8 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. Drainage Piping: Drainage pipe is specified in Division 2 Section "Subdrainage."

B. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a 6-inch course of filter material on drainage fabric to support drainage pipe. Encase drainage pipe in filter material and wrap in drainage fabric, overlapping sides and ends at least 6 inches.

3.18 SUBBASE AND BASE COURSES

A. Under pavements and walks, place subbase course on prepared subgrade and as follows:

1. Place base course material over subbase.

2. Compact subbase and base courses 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 1557.

3. Shape subbase and base to required crown elevations and cross-slope grades.

4. When thickness of compacted subbase or base course is 6 inches or less, place materials in a single layer.

5. When thickness of compacted subbase or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.19 DRAINAGE COURSE

A. Under slabs-on-grade, place drainage course on prepared subgrade and as follows:

1. Compact drainage course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

2. When compacted thickness of drainage course is 6 inches or less, place materials in a single layer.

3. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.20 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing. Additional testing requirements due to test failure will be at the expense of the Contractor.

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 one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two tests.

3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 200 feet or less of trench length, but no fewer than two tests.

4. Curb and Gutter: With grade less than 0.5 percent, one random test per lift per 200 feet. With grade greater than 0.5 percent, one random test per lift per 400 feet.

5. Sidewalk: One random test per lift per 400 feet.

6. Roadway: One random test per lift per 1000 square yards.

7. Landscape Areas: No specific requirements.

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 the 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.

END OF SECTION-

SECTION 02510 - WATER DISTRIBUTION

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 water-distribution piping and specialties outside the building for the following:

1. Water services.
2. Fire-service mains.
3. Aboveground water piping for applications other than water-service piping.
4. Water Meters.

1.3 DEFINITIONS

A. Fire-Service Main: Exterior fire-suppression-water piping.

B. Fire-Suppression-Water Piping: Interior fire-suppression-water piping.

C. Water-Distribution Piping: Interior domestic-water piping.

D. Water Service: Exterior domestic-water piping.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Valves and accessories.
2. Fire hydrants.
3. Water Service Piping.
4. Water Meters.

B. Operation and Maintenance Data: For specialties to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:

1. Valves.

2. Fire hydrants.

3. Water Meters.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of piping and specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.

2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

D. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.

2. Protect valves against damage to threaded ends and flange faces.

3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping 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.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

1.7 PROJECT CONDITIONS

A. 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.

1.8 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 – PRODUCTS

2.1 PIPE AND PIPE FITTINGS, GENERAL

A. Pipe and pipe-fitting materials shall be compatible with each other. Supply pipe, pipe fittings and appurtenances in accordance with authority having jurisdiction.

B. Polyvinyl Chloride: AWWA C900 or PVC 1120, DR 18.

C. Contractor shall provide magnetic markers on each pipe at 50 feet maximum spacing and at all bends or changes of alignment. Contractor to coordinate with authority having jurisdiction.

2.2 CORROSION-PROTECTION ENCASEMENT FOR PIPING

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

2.3 GATE VALVES

A. Valves, Valve Boxes, Tapping Sleeves, Tapping Saddles, and Other Appurtenances: Type specified by Authority having jurisdiction or as shown on Drawings, and compatible with pipe and fittings specified.

B. Nonrising Stem Gate Valves 2 Inches to 12 Inches: AWWA C509-80, resilient seated; bronze stem, cast-iron or ductile-iron body and bonnet, 2 inch stem nut, 200-psi working pressure, joint ends as required by utility owner.

C. Valve Boxes: Cast-iron box having top section and cover with lettering "WATER", bottom section with base of size to fit over valve and barrel approximately 5 inches in diameter, and

screw adjustable cast-iron extension of length required for depth of bury of valve. Provide traffic lids as required by authority having jurisdiction.

2.4 ANCHORAGES

A. Perform anchorages in accordance with authority having jurisdiction/requirements and as shown on Drawings. Provide sufficient anchorages, sized in accordance with pressure rating of pipe being installed.

B. Clamps, Straps, and Washers: ASTM A 506, steel.

C. Rods: ASTM A 575, steel.

D. Rod Couplings: ASTM A 197, malleable iron.

E. Bolts: ASTM A 307, steel.

F. Cast-Iron Washers: ASTM A 126, gray iron.

G. Anchoring Pipe and Fittings: According to Authority having jurisdiction and the applicable pipe specifications.

H. Concrete Reaction Backing: Portland cement concrete mix, 3000 psi.

1. Cement. ASTM C 150, Type 1.

2. Fine Aggregate: ASTM C 33, sand.

3. Coarse Aggregate: ASTM C 33, crushed gravel.

4. Water: Potable.

2.5 FREESTANDING FIRE HYDRANTS

A. Mueller Super Centurion (confirm with authority having jurisdiction).

B. Hydrant Requirements: Conform to AWWA C502.

2.6 WATER METERS

A. Turbine Meter.

B. Meter Requirements: Conform to AWWA C701.

PART 3 – EXECUTION

3.1 EARTHWORK

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPE AND PIPE FITTING APPLICATIONS

A. Pipe: Install in accordance with manufacturer recommendations and as directed by authority having jurisdiction.

B. Depth of Cover: Minimum cover for frost protection is 5 feet.

C. Water Main Connections: Connect to existing water main in locations indicated, in accordance with requirements of water provider. Coordinate connection with authority having jurisdiction at least 48 hours in advance of connections.

D. Water Service Terminations: Provide connections to existing water service lateral.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical joint end valves for 3-inch and larger buried installation.

B. AWWA-type Gate Valves: Comply with AWWA C600. Install buried valves with stem pointing up and with cast-iron valve box and traffic lid as required.

3.4 ANCHORAGE APPLICATIONS

A. Anchorages: Provide anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in accordance with authority having jurisdiction. Provide anchorage equal to pressure rating of pipe or fittings used.

B. Provide Mega Lug followers on all bends.

3.5 PROTECTIVE COATING APPLICATIONS

A. Apply full coat of 20 mil epoxy coating or other corrosion-retarding material acceptable to authority having jurisdiction to surfaces of installed ferrous anchorage devices.

3.6 FIRE HYDRANT APPLICATIONS

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.

C. AWWA-Type Fire Hydrants: Comply with AWWA M17.

D. Type, size, and location for fire hydrants shall be reviewed with authority having jurisdiction.

3.7 WATER METER APPLICATIONS

A. General: Install per manufacturers installation instructions.

3.8

3.9 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. See Division 2 Section "Earthwork" for underground warning tapes.

3.10 FIELD QUALITY CONTROL

A. Testing

1. All testing must be witnessed. The Contractor shall notify authority having jurisdiction, Owner's Representative and the Architect at least 72 hours in advance of performing testing.

2. Conduct both a pressure test and a leakage test on the main, appurtenances and hydrants. Conduct test in accordance with AWWA C600-93 and authority having jurisdiction Specifications.

3. Test all watermains and appurtenance in sections of length acceptable to authority having jurisdiction.

4. Take all necessary precautions to prevent dirt, debris, or other foreign material from entering the watermain, services, or appurtenances. Remove such material from the watermain, services or appurtenances at no additional expense to the Contract.

5. If no local testing requirements are available, use the following formula for allowable leakage=L(gph).

$$L=SD(P)\ ^{\wedge}\ .5/(133,200)$$

S = Length of pipe tested (feet).

D = Nominal diameter of the pipe, (inches).

P = Average pressure during leakage test,)psig).

6. If a section fails to pass the pressure or leakage tests, locate, uncover, repair or replace, and retest defective work or material at no additional expense to the Contract and without extension of time for completion of the work. Repair materials, methods and procedures subject to approval of authority having jurisdiction.

B. Disinfecting and Flushing

1. The Contractor shall notify authority having jurisdiction, Owner's Representative, and the Architect at least 72 hours in advance of performing disinfection and flushing of watermains. This process must be witnessed.

2. Perform disinfection and flushing operations in accordance with AWWA C651-92, AWWA C652, and authority having jurisdiction Specifications.

3. After chlorination period is complete, flush system completely so residual chloride is the same as feeding system. Do not place mains into service until authority having jurisdiction has reviewed the water quality and released the system for public use.

4. At the completion of all disinfection and flushing the Contractor shall provide the Owner with a NFPA 24 Underground Flush Certificate.

END OF SECTION

SECTION 02530 - SANITARY SEWERAGE

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 sanitary sewerage outside the building.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for concrete structures.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Manhole cover inserts.

B. Shop Drawings: Include plans, elevations, details, and attachments for the following:

1. Precast concrete manholes, including frames and covers.

C. Design Mix Reports and Calculations: For each class of cast-in-place concrete.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

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.

PART 2 –PRODUCTS

2.1 PIPING MATERIALS

A. General: Provide pipe and pipe fitting materials compatible with each other. Provide materials specified by authority having jurisdiction or as indicated on Drawings. Where more than one type of materials or products is indicated, selection is subject to Architect's review.

B. PVC Sewer Pipe and Fittings: ASTM D 3034, SDR 35, unless otherwise shown on Drawings, use elastomeric seal gasket joints.

1. Gaskets: ASTM D3212, elastomeric seal.

2.2 MANHOLES

A. Precast Concrete Manholes: ASTM C 478, precast reinforced concrete, of depth indicated with provision for joints

1. Riser Sections: 5-inch minimum thickness for 48-inch minimum diameter and 6" minimum thickness for 60-inch diameter, and lengths to provide depth indicated.

2. Top Sections: Top of cone to match grade rings. Minimum top opening for frame and cover: 24 inches.

3. Gaskets: ASTM C 443, rubber unless Authority having jurisdiction accepts alternate.

4. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

5. Channel and Bench: Type required by Authority having jurisdiction or as shown on Drawings; concrete or half pipe.

6. Joint between manhole and pipe: Press wedge type as reviewed by Engineer.

B. Concrete: Portland cement mix, 4000 psi, per "Cast-In-Place Concrete"

1. Cement: ASTM C 150, Type I or II.

2. Fine Aggregate: ASTM C 33, sand.

3. Coarse Aggregate: ASTM C 33, crushed gravel.

4. Water: Potable.

C. Precast Adjustment Rings: Pre-cast, reinforced concrete rings per ASTM C-478 with inside diameter equal to inside diameter of frame and used to set frame and cover to grade.

1. Minimum Compressive Strength: 4000 psi in 28 days, with 5 to 7 percent air content.

2. Minimum of 6" adjustment and maximum of 12" adjustment.

D. Manhole Frames and Covers: ASTM A48, Class 30, of type required by Authority having jurisdiction as well as lettering on cover. Coat exterior with asphaltum paint.

2.3 CLEANOUTS

A. Supply cleanouts of same pipe and fitting material as lateral unless required otherwise on Drawings.

B. Cleanout Cover: Cast iron, ASTM A48, Class 30 as shown on Drawings or as required by authority having jurisdiction.

PART 3 – EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 IDENTIFICATION

A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.

1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 INSTALLATION, GENERAL

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 using lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use 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. Extend sanitary sewerage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.

3.4 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. Join and install PVC pipe as follows:

1. Pipe and gasketed fittings, joining with elastomeric seals in accordance with ASTM C 3212 and manufacturer recommendations.

3.5 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Form continuous concrete channels and benches between inlets and outlet.

C. 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.

D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

E. Provide rubber joint gasket complying with ASTM C 443 at joints of sections

F. Grout joints as required to make watertight.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Set cleanout frame and cover 1 inch above surrounding earth grade or flush with grade when installed in paving. Protect cleanout frame and cover until final acceptance of Contract.

B. Install cleanout in appropriate encasement and in accordance with applicable pipe requirements.

3.7 SEWER CONNECTIONS

A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work. Perform work in accordance with authority having jurisdiction.

B. 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 3000 psi 28-day compressive-strength concrete.

C. Make branch connections from side into existing piping by curing a hole in the existing pipe and installing the appropriate saddle or sleeve fitting onto existing piping. Encase entire system with not less than 6 inches of 3000 psi 28-day compressive-strength concrete.

D. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete or other extraneous material that may accumulate.

3.8 CLOSING ABANDONED SANITARY SEWERAGE 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 Structures: Excavate around structure as required and use one procedure below:

1. Remove structure and close open ends of remaining piping.

2. Remove top of 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.

3. Backfill to grade according to Division 2 Section "Earthwork."

3.9 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.

2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. 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.

C. 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 reports for each test.

5. If authorities having jurisdiction do not have published procedures, perform tests as follows:

a. Sanitary Sewerage: Perform air test according to UNI-B-6.

6. Manholes: Perform hydraulic test according to ASTM C 969.

7. Leaks and loss in test pressure constitute defects that must be repaired.

8. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION

SECTION 02630 - STORM DRAINAGE

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 storm drainage outside the building.

B. Related Sections include the following:

1. Division 2 Section "Subdrainage" for foundation drains connecting to storm drainage.

2. Division 3 Section "Cast-in-Place Concrete" for concrete structures.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

B. Force-Main Pressure Ratings: At least equal to system operating pressure, but not less than 150 psig.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Storm water disposal systems.

B. Shop Drawings: Include plans, elevations, details, and attachments for the following:

1. Precast concrete manholes and other structures, including frames, covers, and grates.

2. Cast-in-place concrete manholes and other structures, including frames, covers, and grates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

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.

PART 2 – PRODUCTS

2.1 PIPES AND FITTINGS

A. General: Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products is indicated, selection is subject to Engineer's review.

B. Polyethylene: ASTM F 450, ASTM F 667, ASTM D 2321, ASTM D 3034 (sanitary sewer), AASHTO M-252, AASHTO M294, 4 inch through 36 inch (storm drain), 4 inch through 28 inch (sanitary sewer), Pipe shall be corrugated exterior with smooth interior.

C. Polyvinyl Chloride (PVC): ASTM 3034, SDR 35, 4 inch through 15 inch.

D. Concrete or Reinforced Concrete: ASTM C14 & C76.

E. Fittings for storm drainage applications shall be thermal molded PVC meeting SDR-35 specification with leak resistant neoprene gasket.

2.2 CATCH BASINS AND CLEANOUTS

A. Precast Concrete Catch Basins and Cleanouts: ASTM C 478 or ASTM C 858, precast reinforced concrete, of depth indicated. Section shall have provision for joints. Provide catch basins to the dimensions indicated on the Drawings. Minimum opening: 24" by 24" unless otherwise shown on Drawings. Minimum wall thickness: 6"; minimum base slab thickness: 6".

1. Base Section: Base riser section and separate base slab, or base riser section with integral floor.

2. Riser Sections: Sections shall be of lengths to provide depth indicated.

3. Gaskets: ASTM C 443, rubber unless Authority having jurisdiction accepts alternate.

4. Sump as indicated.

2.3 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:

1. Cement: ASTM C 150, Type I or II.

2. Fine Aggregate: ASTM C 33, sand.

3. Coarse Aggregate: ASTM C 33, crushed gravel.

4. Water: Potable.

B. Portland Cement Design Mix: 5000 psi minimum, with 0.45 maximum water-cementitious ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

3. Grout: 2,500 psi.

4. Air Entrainment: 5 to 7 percent.

C. Minimum Cement content per cubic yard:

1. 4000 psi: 6.5 sacks.

2. 5000 psi: 7.0 sacks.

2.4 DRAINS

A. Trench Drains: As shown on the Drawings or equal.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 IDENTIFICATION

A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.

1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 INSTALLATION, GENERAL

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.

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. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use catch basins or cleanouts for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use 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. Install gravity-flow piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

F. Install force-main piping between and connect to building's storm-drainage force main and termination point indicated.

3.4 CATCH-BASIN AND CLEANOUT INSTALLATION

A. Construct catch basins and cleanouts to sizes and shapes indicated.

B. Set frames and grates to elevations indicated. Align rectangular grates parallel to curb, parking lines, gutter, edging or other applicable line of reference.

3.5 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.

B. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.6 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 Structures: Excavate around structure as required and use one procedure below:

1. Remove structure and close open ends of remaining piping.

2. Remove top of 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.

3. Backfill to grade according to Division 2 Section "Earthwork."

3.7 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.

2. Place plug in end of incomplete piping at end of day and when work stops.

3. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. 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.

C. 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 reports for each test.

5. Where authorities having jurisdiction do not have published procedures, perform tests as follows:

   a. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than one and one-half times maximum system operating pressure, but not less than 150 psig.

      1) Ductile-Iron Piping: Test according to AWWA C600, Section "Hydraulic Testing."

      2) PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

6. Leaks and loss in test pressure constitute defects that must be repaired.

7. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 02630

SECTION 02741 - HOT-MIX ASPHALT 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. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.
3. Pavement-marking paint.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for aggregate subbase and base courses and for aggregate pavement shoulders.
2. Division 2 Section "Pavement Joint Sealants" for joint sealants and fillers at paving terminations.

1.3 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. DOT: Department of Transportation.

1.4 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specifications of state or local DOT.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: For each job mix proposed for the Work.

C. Samples: For each paving fabric, 12 by 12 inches minimum.

D. Qualification Data: For manufacturer.

E. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.

C. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

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 or if the following conditions are not met:

1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.

2. Slurry Coat: Comply with weather limitations of ASTM D 3910.

3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.

4. Asphalt Surface Course: Minimum surface temperature of 40 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, 50 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 properly 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, properly cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 10 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-10 or AC-20.

B. Asphalt Cement: ASTM D 3381 for viscosity-graded material ASTM D 946 for penetration-graded material.

C. Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30 or MC-70.

D. 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.

E. Water: Potable.

F. Undersealing Asphalt: ASTM D 3141 or AASHTO M 238, pumping consistency.

2.3 AUXILIARY MATERIALS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than 3 minutes.

1. Color:Blue for handicapped requirements, yellow for fire lanes, white elsewhere.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types."

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

2. Provide mixes complying with composition, grading, and tolerance requirements in ASTM D 3515 for the following nominal, maximum aggregate sizes:

a. Base Course: 1 inch.

b. Surface Course: 1/2 inch.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

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 6 inches minimum 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. 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.

C. Patching: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

3.3 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 base course in 8-inch lifts maximum.

2. Place hot-mix asphalt surface course in 4-inch lifts maximum.

3. Spread mix at minimum temperature of 250 deg F.

4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.

5. 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.

3.4 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 as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."

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.

3.5 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 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: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 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. 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.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.

2. Surface Course: Plus 1/4 inch, no minus.

B. 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. Base Course: 1/4 inch.

2. Surface Course: 1/8 inch.

3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.7 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 30 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.

3.8 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. Testing will be coordinated by the Campus Design & Construction Project Manager. Additional testing due to test failure shall be specified at the expense of the contractor.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. 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.

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.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.9 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 excavated materials to accumulate on-site.

END OF SECTION

SECTION 02751 - CEMENT CONCRETE PAVEMENT

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 exterior cement concrete pavement for the following:

1. Driveways and roadways.
2. Parking lots.
3. Curbs and gutters.
4. Walkways.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for subgrade preparation, grading, and subbase course.
2. Division 2 Section "Pavement Joint Sealants" for joint sealants within concrete pavement and at isolation joints of concrete pavement with adjacent construction.
3. Division 3 Section "Cast-in-Place Concrete" for general building applications of concrete.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

C. Samples: 10-lb sample of exposed aggregate.

D. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials and aggregates.
2. Steel reinforcement and reinforcement accessories.

3. Fiber reinforcement.

4. Admixtures.

5. Curing compounds.

6. Applied finish materials.

7. Bonding agent or adhesive.

8. Joint fillers.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed pavement 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. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

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. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

E. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities. Contractor shall coordinate with authority having jurisdiction for procedures to prepare traffic management plan.

PART 2 – PRODUCTS

2.1 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. Concrete forms shall be of sufficient rigidity to support construction or may be slip form equipment for construction of curb and getter where long, straight portions are involved.

2. Use flexible or curved forms for curves of 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.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.

C. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.

D. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed.

E. Epoxy-Coated Reinforcement Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, deformed bars.

F. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

G. Plain Steel Wire: ASTM A 82, as drawn.

H. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A coated, plain steel.

I. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

J. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.

K. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

L. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

M. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

2.3 CONCRETE MATERIALS

A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.

B. Portland Cement: ASTM C 150, Type I or II.

1. Fly Ash: ASTM C 618, Class F or C.

2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Blended Hydraulic Cement: ASTM C 595M, Type IS, portland blast-furnace slag cement.

D. Blended Hydraulic Cement: ASTM C 595M, Type IP portland pozzolan cement.

E. Blended Hydraulic Cement: ASTM C 595M, Type I (PM) pozzolan-modified portland cement.

F. Blended Hydraulic Cement: ASTM C 595M, Type I (SM) slag-modified portland cement.

G. Aggregate: ASTM C 33, uniformly graded, from a single source, with coarse aggregate as follows:

1. Class: 4S.

2. Class: 4M.

3. Class: 1N.

4. Maximum Aggregate Size: 3/4 inch nominal.

5. Do not use fine or coarse aggregates containing substances that cause spalling.

H. Water: ASTM C 94.

2.4 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

G. Calcium Chloride shall not be used as an admixture.

H. Pozzolans: Replacement allowed up to 15 percent of cement with a 1.5 to 1 replacement ratio. Contractor shall ensure that loss of ignition at less than 1 percent and water requirements not exceed 100 percent.

I. Synthetic fibrous reinforcement: Specify collated, fibrillated polypropylene with a mix ratio of 1.5 pounds of fiber to 1.0 cubic yards of concrete.

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.

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. Pavement-Marking Paint: Latex, water-base emulsion; ready mixed; complying with FS TT-P-1952.

1. Color: Blue for handicapped requirements, yellow for fire lanes, white elsewhere.

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 and grade to suit requirements, and as follows:

1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXES

A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

B. Contractor to have supplied only one type and brand of cement from same mill, and one source of coarse and fine aggregate.

C. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.

1. Do not use Owner's field quality-control testing agency as the independent testing agency.

D. Proportion mixes to provide concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi, 6.0 bags.

2. Maximum Water-Cementitious Materials Ratio: 0.45.

3. Slump Limit: 4 inches.

E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus 1.5 percent:

1. Air Content: 5.5 percent for 1-1/2-inch maximum aggregate.

2. Air Content: 6.0 percent for 1-inch maximum aggregate.

3. Air Content: 6.0 percent for 3/4-inch maximum aggregate.

G. A computerized ticket with each batch to be delivered to the project manager that includes the following information:

1. Name of ready-mix batch plant.

2. Serial number of ticket.

3. Date and number of truck.

4. Name of Contractor.

5. Specific designation of job (name and location).

6. Volume of concrete (number of cubic yards).

7. Time batch was dispensed to truck.

8. Reading of revolution counter at first addition of water.

9. Signature or initials of ready-mix representative.

10. Type and brand of cement.

11. Amount of cement (can be indicated by weight or quantity).

12. Total water content by producer (can be indicated by weight or quantity).

13. Water added by receiver of concrete and his initials (can be indicated by weight or quantity).

14. Admixtures and amount of same.

15. Maximum size of aggregate.

16. Weights of fine and coarse aggregates.

17. Indication that all ingredients are as previously certified or approved.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

B. Project-Site Mixing: Comply with requirements and measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixers of 1 cu. yd. or smaller capacity, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.

2. For mixers of capacity 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, mix type, mix time, quantity, and amount of water added.

PART 3 – EXECUTION

3.1 PREPARATION

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 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.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. 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.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

3.4 JOINTS

A. General: Construct 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. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.

2. Provide tie bars at sides of pavement strips where indicated.

3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

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 40 feet, unless otherwise indicated.

2. Expansion joints shall be 1/2 inch thick asphalt impregnated premolded fiber complying with ASTM D 1751.

3. Extend joint fillers full width and depth of joint.

4. Terminate joint filler less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.

5. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

6. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

7. 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.

8. Joint Sealant shall be a one part non-priming polyurethane sealant, gray in color. The Sealant shall conform to federal specification TT-S-00230c, Type II, Class A.

D. Contraction Joints: Form weakened-plane contraction joints at 10 feet maximum intervals both directions. 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 groover tool to the following radius. Repeat grooving of

contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.

a. Radius: 1/4 inch.

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 the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

1. Radius: 1/4 inch.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, 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 the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

E. 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.

F. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.

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.

G. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form 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 dry-shake surface treatments.

H. 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.

I. 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.

J. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 90 percent of its 28-day compressive strength.

K. 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. Heating of the concrete aggregate must be approved by Campus Design & Construction.

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.

4. Contractor shall protect concrete from freezing during curing period by means of an insulating covering and/or heating for a period of not less than 10 days after placing.

5. No combustion heating shall be allowed during the first 24 hours unless precautions are taken to prevent exposure to exhaust gases.

L. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. 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 reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

4. Measures should be taken to maintain both concrete strength and air entrainment at higher temperatures. If addition water is required to maintain consistency, additional cement and air entrainment admixture should be required as needed.

3.6 CONCRETE FINISHING

A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the 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. 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.

2. After final floating, apply a hand-trowel finish followed by a broom finish to concrete. Cure concrete with curing compound recommended by dry-shake material manufacturer. Apply curing compound immediately after final finishing.

3.7 CONCRETE PROTECTION 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 follow recommendations in ACI 305R for hot-weather protection during curing.

B. 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.

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

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 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.

4. The concrete curing compound shall be acrylic based with a minimum of 18 percent solids and a moisture loss of o.o31 grams per cubic centimeter maximum after 72 hours. Contractor shall apply two coats compound immediately after surface water

dissipation and concrete finishing and at approximately 28 day from placement.
PAVEMENT TOLERANCES

E. 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.

3.8 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 28 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.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article. Testing shall be coordinated with authority having jurisdiction. Additional testing due to test failure shall be at the contractor's expense.

B. Testing Services: Testing shall be performed according to the following requirements:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.

2. Slump: ASTM C 143; one test on every truck load. Additional tests will be required when concrete consistency changes.

3. Air Content: ASTM C 231, pressure method; one test on every truck load.

4. Concrete Temperature: ASTM C 1064; one test on every truck load.

5. Compressive-Strength Tests: ASTM C 39; three cylinder every 50 cu. yd.. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.

6. When frequency of testing will provide fewer than five compressive-strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.

8. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi.

C. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as the sole basis for approval or rejection.

E. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet 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 until concrete has reached 90 percent of design concrete strength. 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

SECTION 02764 - PAVEMENT 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 the following:

1. Expansion and contraction joints within portland cement concrete pavement.

2. Joints between portland cement concrete and asphalt pavement.

B. Related Sections include the following:

1. Division 2 Section "Hot-Mix Asphalt Paving" for constructing joints between concrete and asphalt pavement.

2. Division 2 Section "Portland Cement Concrete Paving" for constructing joints in concrete paving.

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: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

D. Product Test Reports: From a qualified testing agency indicating joint sealants comply with requirements, based on comprehensive testing of current product formulations.

1.4 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. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturer, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test methods 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 nine pieces of each type of material, including joint substrates, joint-sealant backer materials, secondary seals, and miscellaneous material.

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 the use of specially formulated primers.

5. Testing will not be required if joint sealant manufacturer submits 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.

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. 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.

2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than that allowed by joint sealant manufacturer for application indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 – PRODUCTS

2.1 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.

2.2 COLD-APPLIED JOINT SEALANTS

A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.

B. 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.

C. Multicomponent Low-Modulus Sealant for Concrete and Asphalt: Proprietary formulation consisting of reactive petropolymer and activator components producing a pourable, self-leveling sealant.

2.3 HOT-APPLIED JOINT SEALANTS

A. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.

B. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.

2.4 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 Rod for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depths 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 depths, 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 depths and prevent bottom-side adhesion of sealant.

2.5 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.

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.

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 applicable to 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. 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 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.

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 so installations with repaired areas are indistinguishable from the original work.

END OF SECTION

SECTION 02810 - LANDSCAPE IRRIGATION SYSTEM

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall construct an automatic irrigation system, complete and operable, all in accordance with the requirements of the Contract Documents.

B. Said irrigation system shall include but not be limited to all pipes, fittings, sprinklers, valves, automatic control valves, controllers, valve boxes, drain valves, hose Bibb valves, operating wrenches, riser assemblies, direct burial wires, electrical connections, wiring and other appurtenances, piping, connections, testing, cleaning-up, maintenance and adjustments necessary for a complete operating system, ready for immediate use upon completion. Minor irrigation items necessary for proper construction and functional operation of this system, not specifically described in the Contract Documents, and shall be included as a part of the work of this Section.

C. The Section cross references the following sections:

1. Contractor Submittals 01300
2. Landscaping - 02900
3. Mill Piping - Exposed and Buried 15450
4. Plumbing Specialties - 15430

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes: All codes, as referenced herein, are as specified in Section 01090

B. Commercial Standards.

ASTM B 3	Specification for Soft or Annealed Copper Wire
ASTM D2564	Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
AWWA C 500	Gate Valves for Water and Sewerage Systems

1.3 CONTRACTOR SUBMITTALS

A. Manufacturer's literature, samples (where requested by the LANDSCAPE ARCHITECT, HERE IN REFEREED TO AS L.A.), and installation instructions shall be submitted in accordance with Section 01300, "Contractor Submittals."

B. Record drawings, showing locations of all valves, pipes (lines), heads, dimensions, controllers, control lines, and electrical wires shall be submitted prior to final inspection.

C. Controller literature, specifications, installation wiring diagram, and circuit breaker information shall be submitted to the L.A. for review prior to ordering.

D. Equipment for Operation: The CONTRACTOR shall provide the following equipment, in addition to what is shown.

1. Two keys for locking automatic controller door.
2. One stop and waste valve key. (Gate valve Key)

E. A reduced copy of the irrigation plan shall be laminated and mounted on the wall in the room where the central controller is located in addition to a reduced copy in each controller.

1.4 QUALITY ASSURANCE

A. In addition to other inspection, as provided by the L.A. and or OWNER, the CONTRACTOR shall give at least 72 hours notice to the L.A. for scheduling the following special inspections:

1. Layout of the system
2. Inspection of trenches, backfilling, and equipment.
3. Pressure tests
4. Coverage adjustment
5. Automatic operation

B. The CONTRACTOR shall notify the L.A. at least 72 hours prior to performing the tests. All tests shall be performed in the presence of the L.A... Test requirements shall be as follows:

1. After assembly and installation, all water pipes, fittings, automatic equipment, and appurtenances shall be tested at a hydrostatic pressure of 150 psi at the lowest point of the system for not less than 60 minutes.

2. The first test shall be made in such a manner that all valves in the new water pipe sprinkler lines will be tested for watertight closure. Valves may be tested in groups or singly while subjected to 150 psi water pressure for a period of not less than 60 minutes.

3. The second test shall be made by forcing all air from the pipes with water and capping or plugging pipe risers. After the pipe risers have been plugged or capped, all line valves shall be fully opened and the pipe lines subjected to the full static water pressure for a period of not less than 120 minutes. Pressure pipelines 150 PSI).

4. The third test required that lateral lines be tested at 100 psi for 120 minutes.

5. The fourth test requires that all pressure lines be tested at 120 psi for 24 hours.

6. Water lines and valves which show evidence of leakage or fail to be watertight shall be repaired or replaced. After all repairs or replacements have been made, the above-required tests shall be performed again.

7. When the sprinkler system is completed, the CONTRACTOR, in the presence of the L.A., shall perform test coverage of water afforded the lawn and planting areas. The CONTRACTOR shall furnish all material and perform all work required to correct any inadequacies of coverage disclosed. The CONTRACTOR shall inform the L.A. of any deviation from the Drawings required due to wind, planting, soil, or site conditions that bear on proper coverage.

8. Upon completion of each phase of the work, the CONTRACTOR shall check and adjust each sprinkler head to meet the site requirements and the requirements of the Contract Documents.

(Testing as noted in 1 through 5 is at the owners option, and generally will note be required unless verification of the contractors ability is required.)

1.5 INSTRUCTION

A. The CONTRACTOR shall, upon completion of the maintenance period of the irrigation instruct the OWNER and the OWNER'S personnel as to the proper operation and maintenance of the system.

1.6 EXISTING UTILITIES AND CONDITIONS

A. Prior to cutting into the soil, the CONTRACTOR shall locate all cables, conduits, sewers, septic tanks, and other such underground utilities, and shall take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, the CONTRACTOR shall promptly notify the L.A...

B. The CONTRACTOR shall be responsible for coordinating its work with the operation of existing utilities and new utilities on the Project. The CONTRACTOR shall notify the L.A. or its representative when utilities which are in operation require shut-off.

C. Due to the scale of Drawings, it is not possible to indicate all offset, fittings, etc., which may be required. The CONTRACTOR shall carefully investigate the structural and finished conditions affecting all its work, and plan its work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. The Contract Documents are generally diagrammatic and indicative of the work to be installed. The work shall be installed in the most direct and workmanlike manner, so that conflicts between sprinkler systems, planting, structures, piping, and etc. will be avoided.

D. The CONTRACTOR shall verify the water pressure available at the site before installation of the system to make sure there is adequate pressure (design pressure 80 psi) to properly operate sprinkler heads and valves, and shall also provide pressure reducing valves if required before commencement of any work. Minor additions and adjustments of heads, piping, and circuits shall be made at no additional cost to OWNER where it is necessary to make the irrigation system operate properly.

1.7 STORAGE OF MATERIALS

A. The CONTRACTOR shall be responsible for storage of materials and for damage to the WORK covered by these Contract Documents before final acceptance of its work. The CONTRACTOR shall securely cover openings into the system, and shall cover all apparatus, equipment, and appliances both before and after being set in place to prevent obstruction in the pipes and the breakage, misuse, or disfigurement of said apparatus, equipment. or appliances.

1.8 SCHEDULING AND COORDINATION

A. The CONTRACTOR shall be responsible for making arrangements for the coordination of its construction operations with those of all others on the job. The CONTRACTOR shall permit others engaged in work to accomplish their portion of the WORK without undue interference or delay.

B. The CONTRACTOR shall be responsible for the scheduling and coordination of the electrical and water connections and the installation of the piping and equipment in a manner that will effect the earliest completion of the WORK in conformance with the construction progress schedules.

1.9 GUARANTEE/WARRANTY OF THE IRRIGATION SYSTEM

A. The CONTRACTOR shall guarantee the complete irrigation system to be free from leaks or breakage due to defective material or workmanship for a period of one year from the date of acceptance of the complete work by the OWNER. Damage due to sabotage and/or vandalism is specifically excepted from this guarantee.

B. Other items of the required guarantee shall be as specified in the Section 02900, "Landscaping"

C. The CONTRACTOR shall repair any settling of backfilling trenches occurring during a one year period after final acceptance without expense to the OWNER including complete restoration of all damaged planting, paving, or other improvements of any kind.

D. The CONTRACTOR shall provide winterization of the irrigation system during the one year guarantee period.

E. When defective material or workmanship is discovered which will require repair or replacement, all such repair work or replacement work shall be done by the CONTRACTOR at its own expense within 24 hours after written notification is given to the CONTRACTOR by the OWNER of such required repairs. However, if the CONTRACTOR fails to comply with the requirements of the above guarantee within the 24 hours after notification is given, the OWNER shall proceed to have the repairs made by others at the CONTRACTOR'S expense.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Brand names specified for materials are supplied for the purpose of describing the type, size, quality, and performance of materials. The CONTRACTOR may propose, as substitutions, other manufacturers' materials of equal quality and performance to the L.A. for review in accordance with Section [01300], "Contractor Submittals."

B. The CONTRACTOR shall furnish, at no additional charge, all samples necessary for testing as outlined in the Specifications or, when requested, certified evidence of off-site testing.

C. Equipment compatibility: automatic controller and automatic (remote) control valves shall be products of the same manufacturing company.

2.2 PLASTIC PIPE AND FITTINGS

A. Pipe shall be continuously and permanently marked with the following information: manufacturer's name, nominal pipe size, PVC type, pressure rating, and extrusion date.

B. All plastic pipes for lateral lines shall be PVC (polyvinyl chloride) SDR 21, Schedule 40, NSF approved.

C. Materials for pressure main lines shall be PVC (polyvinyl chloride) SDR 21, Schedule 40, NSF approved, or galvanized steel pipe.

D. Rubber gasket PVC pipe, couplings, and fitting: Conform to ASTM D-1784 Type I, Grade I, 2,000 PSI design stress. Standard dimensional ratio for the pipe shall be SDR 21 class 200. All pipe shall conform to commercial standard CS-256-64 (pressure rated pipe), and National Sanitation Foundation ASTM 1869. Coupling and fittings shall be furnished by the pipe manufacture.

E. All fittings shall be PVC (polyvinyl chloride) Schedule 40, Type II, NSF, and Schedule 80 mainline fitting up to valve on mainline as called for in the Contract Documents.

F. Ductile iron fitting shall be grade 65-45-12 in accordance with ASTM A-536. Fitting shall be deep bell push-on joints with gaskets meeting ASTM F-477. Fittings shall be HARCO DEEP BELL as manufactured by Harrington Corporation of Lynanburg, VA. Transition gaskets are not allowed.

G. Swing joint ells and nipples shall be Schedule 80 PVC, or equal.

2.3 VALVES

A. Isolation valves shall be resilient seated wedge valves.

B. Isolation valves for valve manifolds shall be brass ball valves as manufactured by Apollo, or equal.

C. Remote Control Valves: Remote control valves for the irrigation system shall conform to the following requirements:

1. Control valves shall be plastic, for 24-volt electrically controlled solenoids for operation. They shall be of heavy duty plastic construction with cross or slotted type wheel for operation with key, and bleed fitting.

2. Each group of remote control valve shall be housed in a poly-plastic valve box with locking lid and gravel base.

3. Control valves shall be by the same manufacturer as the controller.

4. Remote control valves shall be RAINBIRD DV (Drip Zones) Series or approved equal.

2.4 AUTOMATIC CONTROLLER

A. The automatic controllers shall be electrically-timed devices for automatically opening and closing remote control valves. All controllers and remote control valves supplied under this contract shall be of the same manufacturer and have similar operational and adjustment

B. The controller shall be enclosed in a weatherproof metal housing having locking cover or covers to protect all adjustment and breakable equipment from vandalism. Exterior

controllers shall be provided with locking covers. Keys for covers shall be interchangeable keys. The controllers shall be wall and pedestal mounted.

2.5 BACKFLOW ASSEMBLY

A. Provide specified backflow assembly and all fittings per plan.

2.6 SPRINKLER HEADS

A. Sprinkler heads shall be the model and type indicated on the Drawings.

B. Rotor pop-up sprinkler heads as manufactured by TORO series or approved equal.

C. Lawn pop-up and Shrubbery adapter spray heads shall be TORO 570Z PRX series head and nozzles, or approved equal.

2.7 DRIP IRRIGATION LINES AND EQUIPMENT

A. Drip lines shall be the model and type indicated on the Drawings.

B. Drip lines and equipment shall be NETAFIM or approved equal.

2.8 CONTROL WIRING

A. Control wire shall be Standard PE Direct Burial Copper Wire, Type UF Bearing, UL approved for direct underground burial in National Electrical Code Class II circuits, AWG sizes.

B. Conductor of electrical conductivity shall be grade copper meeting requirement of ASTM B 3

C. All splices shall be made with wire connectors, such as manufactured by Railbird, Pen Tit, Scotch Lock, or equal.

2.9 PVC SOLVENT CEMENT AND PRIMERS

A. Solvent Cement shall be NSF approved and shall meet requirements of ASTM D 2564.

B. Primer shall be NSF approved and shall be Weld-On, P-70 Industrial Polychemical Service, or approved equal.

2.10 BACKFLOW ENCLOSURE

A. Backflow enclosure shall be sized for equipment, depth of installation, and operation and maintenance space required with locking system as noted on plan.

2.11 OTHER MATERIALS

A. Other materials required or necessary shall be as shown and/or as required for best quality work.

PART 3 -- EXECUTION

3.1 GENERAL

A. Installation of the irrigation system shall be performed after the finish grading, but prior to landscaping.

B. All valves, fittings, heads, and piping shall be installed as shown and all connections made to permit the irrigation system to function properly through its entire length.

C. All materials and equipment shall be installed in strict accordance with manufacturer's written instructions and recommendations and all local and state codes, laws, ordinances, and regulations.

D. Before proceeding with the installation of any section or unit of the irrigation system, the CONTRACTOR shall check and verify the correlation between ground measurements and Drawings and shall advise the L.A. of any discrepancies.

E. The total number of sprinkler heads and circuits and size of pipes shall be not less than shown unless otherwise approved. The stated maximum spacing for each type of sprinkler head shall not be exceeded.

3.2 EXCAVATION

A. Trenches shall be dug as wide and as deep as necessary to properly install the irrigation pipe.

B. Pipe trenches shall be straight, or "snaked" slightly allowing for expansion and contraction of PVC pipe.

C. Subsoil shall be kept separate from topsoil, where possible.

D. Minimum cover depth shall be as follows:

1. Supply pressure lines from water source to control valves: 18 inches unless otherwise shown.

2. Lateral lines from control valves to sprinkler heads; 8 and 12 inches unless otherwise shown. Lateral lines under paving, roadways, and driveways shall have 18 inches of cover and located in Schedule 40 PVC sleeves

3. Trenches for control wire only shall be 18 inches deep unless otherwise shown. Control wires under concrete walks and slabs, paving, roadways, and driveways shall be installed in Schedule 40 PVC sleeves

E. A trench of sufficient width shall be provided to allow for proper tamping around pipe.

3.3 PIPING-GENERAL

A. Piping shall be laid out and installed in accordance with manufacturer's printed recommendations and industry standards. Substantial support shall be provided at all points, and pipes shall be snaked slightly allowing for expansion and contraction.

B. Minimum 1-inch vertical clearance shall be between lines crossing at angles greater than 45 degrees.

C. Minimum 3 inches horizontal and vertical clearances shall be between all other lines.

D. All swing or swivel joints shall provide a leak-resistant joint with freedom of movement.

E. Teflon thread sealant 3/4-inch wide (tape or liquid), Rector seal No. 5, or equal shall be used at all threaded joints.

F. Galvanized steel pipes shall have clean standard threads of standard lengths. Joints shall be made up with pipe compound applied to male threads only and not more than 2 threads shall show at the joints when connected.

G. Pipe sleeves shall be provided under all paving and where necessary for passage under finish surface material, future replacement, and for protection of PVC piping and control wire

3.4 PLASTIC PIPE

A. The pipe shall be guaranteed by the manufacturer to be suitable for operation under the conditions of this installation and shall be guaranteed free from defects in workmanship and quality.

B. The pipe shall be connected by O-ring type or by solvent-weld joints as outlined below. Joints shall be made in strict accordance with the manufacturer's printed recommendation.

C. The plastic pipe sections shall be placed accurately to line and grade in the prepared trenches. The inside of all pipe shall be clean and free from foreign matter and shall be end-reamed to remove burrs and provide full inside diameter of the nine end.

D. Pipe assembly shall have a firm, uniform bearing for the entire length of each pipeline to prevent uneven settlement. All adjustments to grade shall be made by scraping away or filling in with clean earth backfill material, well compacted under the body of the pipe. Wedging of pipe will not be permitted. The inside of all pipes shall be clean and free from foreign materials before joints are assembled.

E. Sealant tape shall be used on all threaded joints.

F. All pipeline open ends upon which the WORK has been stopped shall be closed at the end of each day's construction work with a suitable temporary plug to prevent entrance of any foreign materials into the assembled pipeline.

G. Pressure pipe shall be defined as all piping lying "upstream" from remote control valves and quick-coupling lines.

H. O-Ring type flexible coupling pipe shall be used on pressure pipes 3-inch diameter and larger.

I. Two and one half inch and smaller mainlines and fittings of pressure piping shall be solvent-weld type.

J. Pressure piping 3-inches and larger shall be provided with Portland cement concrete thrust blocks. Thrust blocks shall be constructed at the following places:

1. Where pipe changes direction at fittings.
2. Where pipe changes size.
3. Where line terminates.

K. Thrust blocks shall be constructed of 2000 psi concrete, as noted on plans and details.

L. The areas noted on the details table shall be measured in a place perpendicular to the longitudinal axis of the pipe or to the longitudinal axis of the thrust developed. The thrust block bearing area shall be against undisturbed around.

M. Compression fitting (compression by compression slip joint PVC) shall be provided on mainline at 250 on center for expansion and contraction of mainline on straight runs on solvent welded pipe.

3.5 VALVES

A. Piping systems shall be supplied with valves at all points as shown or specified herein so arranged to give complete regulating control throughout. Automatic control valves and gate valves shall be as detailed in the Contract Documents or as otherwise directed by the L.A...

B. Valves shall be the full size of the line in which they are installed, unless otherwise shown.

C. Remote control valves shall be adjusted so the most remote sprinkler heads operate at the pressure recommended by the head manufacturer. Remote control valves shall be adjusted so a uniform distribution of water is applied by the sprinkler heads to the planting areas for each individual valve system. A union fitting shall be provided on the discharge side of the control valve. They shall be wired to operate in the order as shown. They shall be capable of being operated manually entirely independent of the controller.

D. Quick couplers shall be installed as shown.

E. Gate valves shall be line (pipeline) size, shall be installed where shown, in a valve box.

F. Quick-coupling valves shall be provided, located, and installed as shown.

3.6 BACKFLOW ASSEMBLY

A. Per main connection location provide backflow and vault per plan and details.

3.7 VALVE BOXES

A. Valve boxes shall be set ½-inch above the designated finish grade in lawn areas and 2 inches above finish grade in ground cover areas. Size valve box per number of valves used.

B. All remote control sprinkler valves shall be encased in a valve box.

3.8 SPRINKLER HEADS

A. All nozzles on sprinklers shall be tightened after installation. All sprinklers having an adjustment stem shall be adjusted on a lateral line for the proper radius diameter and/or flow

B. All sprinkler heads shall be set perpendicular to finished grades and at finish ground level.

C. All sprinkler heads shall be installed as detailed on the Drawings.

D. The sprinkler system shall be thoroughly flushed as so to remove all possible foreign material prior to installation of the sprinkler heads.

E. The CONTRACTOR shall protect against re-entry of contaminated water into risers or piping. After flushing, the CONTRACTOR shall immediately install sprinkler heads or cap risers until sprinkler heads are installed.

3.9 CONTROLLERS

A. The CONTRACTOR shall install controller as shown complete with required waterproof circuit breaker type disconnect switch, per manufacturer's printed recommendations.

B. Controller location is essentially diagrammatic, and the actual installation shall be as specifically located by the L.A...

C. All local and applicable codes shall be followed in furnishing and/or connecting a 110-volt electrical service to the controller.

D. The controller shall be wall and pedestal mounted as shown, in such a manner that all normal adjustments can be conveniently reached by the operator while in a standing position.

E. Adjustment of the controller shall be such that each control valve in the circuit will remain open for a readily adjustable period of 5 or less minutes to 60 minutes. Readily made field adjustments shall include a provision whereby any number of days in a week can be skipped and whereby one or more positions on the controller may be skipped. When any or all of the above adjustments have been made, the controller shall continue to operate automatically as set until further adjustments are made. Provision shall be made for conveniently resetting the start of the irrigation cycle at any time and also for advancing from one position to any other position at will.

F. The CONTRACTOR shall properly ground the control boxes to copper ground rods driven into the ground.

G. Timing, sequence and period will be supplied to the CONTRACTOR by the L.A... At this time, the CONTRACTOR shall adjust the controller for normal operation.

H. The controller shall be single-phase; 110-volt (approx.) ac operated and shall contain an "On-Off" switch and fuse assembly. The controllers shall be equipped with a transformer to reduce voltage to a 24-volt system. Controller station shall be provided where shown.

3.10 WIRING AND ELECTRICAL WORK

A. All electrical equipment and wiring shall comply with local and state codes and shall be installed by those skilled and licensed in the trade. Unless the governing codes specify otherwise, low voltage control wire may be installed by the CONTRACTOR when code allows.

B. All 110-volt wire shall be installed in conduit and taken from appropriate sources as shown. CONTRACTOR shall coordinate manufacturer and installer

C. The CONTRACTOR shall provide low voltage, 24-volt direct burial wires. Wire size shall be as shown but shall be not less than No. 14. Where sizes are not shown, they shall be sized per wire manufacturer's sizing charts and specifications.

D. The CONTRACTOR shall provide all wiring, conduits, sleeves, and connection for the low voltage electrical system between controller and valves, and where else shown and necessary for a complete and operable irrigation system.

E. Wires shall be color coded as follows:

1. Control wires shall be red.
2. Ground (neutral) wire shall be white.
3. Extra wires shall be blue.

F. All splices shall be moisture proof using specified electrical connectors.

G. Wires shall be bundled together and wrapped with electrical tape similar to PVC at 20-ft intervals. They shall be buried in separate trench two feet offset from main line.

H. An expansion curl should be provided within 3 ft of each wire connection and at pull box locations.

I. All conduits and sleeves necessary for running wires under concrete, walks, and paving shall be furnished and installed before said concrete, walks, and paving work is installed.

J. Wire shall be continuous without splices except at control valves, and shall be routed in main line trench whenever possible.

K. All wire under paving shall be encased in PVC pipe; changes in direction under paving shall be made with sweep ells.

L. Run two extra wires (different color) to furthest valve group both directions for each controller.

3.11 PIPE TRENCH BACKFILL

A. After pipe and wires have been installed, the trenches shall be backfilled. The backfill operation must provide a firm continuous support for the pipe.

B. Backfill material shall be free of rocks and other materials that may damage the piping.

C. Bottom of trenches shall be smooth and free of sharp rocks and other object that may damage pipe.

D. The initial backfill shall be accomplished by carefully tamping selected material (from material excavated from the trench) under the pipe and between the pipe and the trench.

E. The pipes shall be filled with water and pressurized during backfilling operations if necessary, to prevent drainage to piping.

F. The backfill shall be carefully installed around and over the pipe to approximately 10 inches of the ground surface, then water shall be allowed to flow in the trench. After this puddling operation has been completed and allowed to stand for 24 hours, the balance of the materials shall be placed in the trench to the sub-grade line (leaving room for topsoil) Rocks and other materials found in the backfill shall be removed. The backfill shall be compacted carefully and thoroughly.

G. Couplings and fittings shall be left exposed until leakage tests have been completed.

H. Topsoil shall be installed prior to planting.

3.12 TESTING AND ADJUSTMENTS

A. The L.A. shall be notified by the CONTRACTOR prior to performing hydrostatic tests on the irrigation system in place. This test shall be done by the CONTRACTOR in the presence of the L.A.. The test results will be acceptable to the L.A. when no leakage or loss of pressure is evident during the test period. Defects shall be detected and repaired prior to re-testing.

B. The sprinkler heads shall be adjusted and balanced for optimum and uniform coverage without excessive fogging and overthrow on walks, paving, and structures. The height and elevations of risers and sprinkler heads shall be adjusted.

B. Following adjusting and balancing of the sprinkler heads, an operating test of the entire system shall be performed by the CONTRACTOR in the presence of the L.A. at normal operating pressures. The test will be considered as acceptable if the system operates in a satisfactory manner providing uniform coverage of irrigated areas for a one week period of automatic operation with no leaks.

END OF SECTION 02810

SECTION 02900 - LANDSCAPING PLANTING

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall perform all the landscaping and all appurtenant work, complete, in accordance with the requirements of the Contract Documents.

B. Scope of Work: Landscaping as referred to herein shall include, but not be limited to the following work: soil preparation, installation of headers, weed control, finish grading, furnishing and installing plant materials, tree staking and tying, cleanup, maintenance, and guarantee.

C. The Section cross references the following sections:

1. Reference Standards 01095
2. Contractor Submittals 01300
3. Project Closeout 01700
4. Landscape Irrigation System 02810

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes: All codes, as referenced herein, are specified in Section 01095 - Reference Standards.

B. Federal Specifications:

FS O-F-241 D Fertilizer, Mixed, Commercial

C. Commercial Standards

ANSI/ASTM D 422 Method for Particle-Size Analysis of Soils
ANSI Z601 Nursery Stock
American Association of Rules and Grading Provisions Nurserymen, Inc.

1.3 CONTRACTOR SUBMITTALS

A. General: The CONTRACTOR shall furnish a certificate with each delivery or bulk material delivery, stating source, quantity, and type of material. All materials shall conform to specification requirements. All certificates shall be delivered to the LANDSCAPE ARCHITECT (here in referred to as L.A.) at time of each delivery. All bulk delivered materials shall be delivered with level load volume plainly marked on the truck bed.

B. Topsoil Report: Topsoil report as well as literature on fertilizers, mulch "Silva-fiber" and seed mixes, shall be submitted as specified in Section 01300 - Contractor Submittals

1.4 QUALITY ASSURANCE

A. General: All plants furnished by the CONTRACTOR shall be true to type or name as shown in the Contract Documents and shall be tagged in accordance with the standard prac-

tice recommended by the Agricultural Code of the State of Utah; however, determination of plant species or variety will be made by the L.A...

B. All plants shall comply with Federal and State laws requiring inspection for plant diseases and infestations. Inspection certificates required by law shall accompany each shipment of plants, and certificates shall be delivered to the L.A...

C. All inspections herein specified will be made by the L.A. or its representative. The CONTRACTOR shall request inspection at least 24 hours in advance of the time inspection is required. Inspection will be required on the following stages of the WORK:

1. During preliminary grading, soil preparation, and initial weeding.

2. When trees are spotted for planting, but before planting holes have been excavated.

3. When finish grading has been completed.

4. When all specified work, except the maintenance period has been completed.

5. Final inspection at the completion of the maintenance period.

D. Plants shall be subject to inspection and approval or rejection by the L.A. at place of growth and upon delivery to the site at any time before or during progress of the WORK and according to:

1. Quantity, quality, size, and variety;

2. Ball and root condition; and

3. Latent defects and injuries resulting from handling, disease, and insects.

E. Plants approved at pre-planting inspection shall still be subject to rejection during planting if found to be below Specifications.

F. Rejected plants shall be identified in an obvious manner, removed from the site and replaced with acceptable equals.

G. Plants shall have been grown in nurseries which have been inspected by the governing authorities. Inspection of plant materials required by City, County, State, or Federal authorities shall be the responsibility of the CONTRACTOR, who shall have secured permits or certificates prior to delivery of plants to site.

1.5 CLEANUP

A. Upon completion of all planting operations, the portion of the project site used for a work or storage area by the CONTRACTOR shall be cleaned of all debris, superfluous materials, and equipment. All such materials and equipment shall be entirely removed from the project site as specified in Section 01700 - Project Closeout.

B. All walks or pavement shall be swept or washed clean upon completion of the WORK of this Section.

C. During the entire Contract period, plant containers that have been cut or removed from plant materials shall be removed from the project site daily, in accordance with the provisions for maintenance and guarantee as specified in Section 01700 - Project Closeout.

1.6 MAINTENANCE OF LANDSCAPE PLANTING PRIOR TO ACCEPTANCE OF PROJECT

A. General: The CONTRACTOR shall be responsible for protecting, watering, and maintaining all planting and irrigation systems until final acceptance of all work under the contract.

B. At time of acceptance of the complete project, the lawn (sod) shall be in place with no bare spots, maintained for 10 days and mowed a minimum of 1 time; the grass shall be at least 1-1/4 to 2 inches in height.

C. Watering: Trees and shrubs shall be thoroughly soaked after planting and provided with additional water at intervals as necessary to provide for good health and growth of the planting.

D. Upon completion of lawn seeding and sodding, the entire area shall be soaked to saturation by a fine spray. The new planting shall be kept watered by the sprinkling system existing on the site during dry weather or whenever necessary for proper establishment of the lawn. Care shall be taken to avoid excessive washing or puddling on the surface and any such damage caused thereby shall be repaired by the CONTRACTOR at its own expense.

E. Protection: The CONTRACTOR shall provide adequate protection to all newly planted areas including the installation of approved temporary fences to prevent trespassing and damage, as well as erosion control, until acceptance.

F. The CONTRACTOR shall replace any materials or equipment it has damaged or which has been damaged by its employees or subcontractors.

G. Partial utilization of the project shall not relieve the CONTRACTOR of any of the requirements contained in the Contract Documents.

H. Mowing of Lawn Areas: First mowing of lawn areas shall begin as soon as the grass has reached a height of 3 inches and subsequent mowing shall be at least once a week, or as often as necessary to maintain all lawn areas at a uniform height of 1-1/2 to 2 inches.

I. All lawns shall be fertilized every 3 weeks with 6 lb of 16-16-8 commercial fertilizer per 1000 sq ft for the first 7 weeks and fertilized thereafter once each 5 months prior to acceptance.

J. Plants shall be maintained in a vigorous, thriving condition by watering, cultivating, weeding, pruning, spraying, and other operations necessary. No trees or shrubs will be accepted unless they are healthy and show satisfactory foliage conditions.

K. All planted areas shall be cultivated at least every 2 weeks and raked smooth, to present a neat appearance, and additional mulch shall be added where necessary.

L. Maintenance shall include, in addition to the foregoing, cleaning, edging, repairs to stakes, wire, and wrappings, the repair of erosion, and all other necessary work of main-

tenance. Sidewalks and other paved areas shall be kept clean while planting and maintenance are in progress.

M. Any and all sprinkler lines broken or disrupted during this construction shall be replaced to proper working order prior to contract work and be acceptable to the OWNER.

1.7 FINAL INSPECTION AND GUARANTEE

A. Inspection of work of lawns and planting will be made at conclusion of maintenance.

B. Written notice requesting inspection shall be submitted to the L.A. at least 10 days prior to the anticipated inspection date.

C. Final acceptance of the WORK prior to guarantee period of the contract will be accepted upon written approval by the L.A., on the satisfactory completion of all work, including maintenance, but exclusive of the replacement of plant material.

D. Any delay in the completion of any item of work in the planting operation which extends the planting into more than one season shall extend the guarantee in accordance with the date of completion given above.

E. The CONTRACTOR shall replace, as soon as weather conditions permit, all dead plants and all plants not in a vigorous, thriving condition which are noted at the end of the one year guarantee period.

F. Plants used for replacement shall be of the same size and variety specified in the plant list. Plants shall be furnished, planted, staked, and mulched as specified.

G. All work done under this contract shall be left in good order to the satisfaction of the OWNER and the L.A. and the CONTRACTOR shall, without additional expense to the OWNER, replace any trees, shrubs, etc., which develop defects or die during the one-year guarantee period.

1.8 GUARANTEE FOLLOWING ACCEPTANCE OF PROJECT

A. General: The CONTRACTOR shall be responsible for a period of one year after date of acceptance of all work under the Contract, for all necessary plant or tree replacements. The CONTRACTOR shall provide a written guarantee to the OWNER from the landscaping subcontractor, embodying the provisions of this Section of the Specifications.

B. The WORK covered by the guarantee portions of these specifications consists of providing all replacements of plants, labor, materials, equipment, and supplies and in performing all operations in connection with guarantees.

C. The CONTRACTOR shall clean-up and remove unused or waste materials from the site and leave the area in a neat condition (satisfactory to the OWNER) whenever it performs work during the guarantee Period.

D. Final Inspection: The OWNER and CONTRACTOR shall make a final inspection at the end of the one-year guarantee period. Any plants and materials found defective at time of final inspection shall be replaced within a time agreed upon by both parties. If it is too late in the planting season for replanting, the replacements shall be made during the next planting season even though such planting may run beyond the maintenance and correction period.

PART 2 -- PRODUCTS

2.1 GENERAL

A. All landscaping materials for soil conditioning, weed abatement, or planting shall be first- grade, commercial quality and shall have certificates indicating the source of material, analysis, quantity, or weight attached to each sack or container or provided with each delivery. Delivery certificates shall be given to the L.A. as each shipment of material is delivered. A list of the materials used, together with typical certificates of each material, shall be submitted to the L.A. prior to the final acceptance of the job.

2.2 TERMINOLOGY AND QUALIFICATIONS

A. Plants or plant material having characteristics not conforming to terms as defined will not be accepted. The terms "plant material" or "plants" refer to all vegetation, whether trees, shrubs, ground cover, or herbaceous vegetation.

B. Quality refers to structure and form, as evidenced by density and number of canes and branches, compactness, symmetry, and general development without consideration of size or condition. Standard quality indicates the least acceptable quality. Plants shall be typical of the species and variety of good average uniform growth, shall be well formed and uniformly branched, and shall have the minimum number of canes specified, free from irregularities, or shall conform to minimum quality index. Where the number of canes is not specifically stated in describing this grade, the standards of the "Horticultural Standards" as adopted by the American Association of Nurserymen, shall apply. In this case, the number of canes and other factors for the appropriate classification under "quality definition" in the Horticultural Standards shall be the Quality index. Plant material below this standard will be considered "culls" and are not acceptable. Plants shall be nursery grown.

C. Specimen means an exceptionally heavy, symmetrical, tightly-knit plant, so trained or favored in its development and appearance as to be outstanding, superior in form, number of branches, compactness, and symmetry.

D. Size is the factor controlled by dimensions representing height or spread, or both, without consideration of quality or conditions. For standard quality, a dimension is given for height or container size, or a dimension is given for height as well as container size.

E. Height is usually indicated with a tolerance. The smaller dimension is the minimum acceptable. The larger dimension represents the maximum permissible. The average dimension of all plants must equal the average of the tolerance figures shown on each item

F. Condition is the factor controlled by vitality and ability to survive and thrive and be comparable with normal plants of the same species and variety in the vicinity, at the same season of the year. In addition, plants shall be free from physical damage or adverse conditions that would prevent thriving. Conditions also sometimes refer to state of growth, i.e., whether "dormant condition" or "growing condition" and this state shall be comparable to plants of similar species in the vicinity or leaves, formation of buds, and the like.

G. Cane means a primary stem which starts from the ground, or close to the ground, at a point not higher than 1/4 the height of the plant.

H. Caliber shall be taken 12 inches above the finish grade or ground, as a guide, or where a dimension in trunk appears to form the head of the tree.

I. Foliage line is maximum dimension in case of specimen plants. It measures from ground to lowest part of body of plant.

J. Collected plants shall not be used.

2.3 TOPSOIL

A. Existing on site topsoil may be stripped and stockpiled on site for landscape use.

B. Imported topsoil shall be obtained from naturally drained areas and shall be fertile, friable loam suitable for plant growth. Topsoil shall be subject to inspection and approval at the source of supply and upon delivery.

C. Imported topsoil shall be of uniform quality, free from subsoil stiff or lumpy clay, hard clods, hardpan, rocks, disintegrated debris, plants, roots, seeds, and any other materials that would be toxic or harmful to plant growth. Topsoil shall contain no noxious weeds or noxious weed seeds.

D. Imported topsoil shall contain at least 6 percent organic matter as determined by loss of weight after ignition of dried (moisture-free) samples in accordance with current methods of the Association of Official Agricultural Chemists.

E. The imported topsoil acidity range of the topsoil shall be (pH 5.5 to pH 7.5). The salinity level shall be less than 3 milliohms/cm.

F. Imported topsoil clay, as determined by the Bouyoucous hydrometer or by the Recantation method, shall not exceed 60 percent of the topsoil material.

G. Mechanical analysis shall be performed and shall conform to ANSI/ASTM D 422. QUALITY ASSURANCE

2.4 FERTILIZER AND ADDITIVES

A. Fertilizer shall be furnished in bags or other standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon.

B. Chemical fertilizers shall be a mixed commercial fertilizer conforming to FS O-F-241 D, Type I, with percentages of nitrogen, phosphoric acid, and potash at 5-10-5 and 16-16-8. The combined N-P-K content shall be following percentages of total weight: 5 percent nitrogen 10 percent phosphoric acid and 5 percent potash. Fertilizers shall be uniform in composition, dry, and free flowing.

C. Tablets shall be 21 grams each 20-10-5 "Agriform," "Lesslie", or equal

2.5 MULCH

A. "Silva-fiber" mulch material shall be "Silva-fiber" as manufactured by the Weyerhaeuser Company, Silva Products Department, Tacoma, Washington, or equal.

B. Shredded bark mulch in planting beds shall be clean, pine bark free of sticks and pieces over 2 inches in size produced by "chipping and shredding" tree branches or similar means, placed to a depth of 4 inches.

2.6 PLANT MATERIALS

A. Plants shall meet requirements of the Contract Documents and shall be in accordance with the botanical names and applicable standards of quality, size, condition, and type. They shall be true to name, genera, species, and variety in accordance with reference publications.

B. Plant names are defined in "Standardized Plant Names" and "Bailey's Encyclopedia of Horticulture." When a name is not found in either reference, the accepted name used in the nursery trade shall apply.

C. Plants shall be marked for identification. Each bundle of plants and at least 25 percent of each species and variety of separate plants in any one shipment shall have legible labels securely attached before delivery to the site.

D. All trees and shrubs shall be measured while 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 will be accepted with their leaders cut, or so damaged that cutting is necessary.

E. All plants shall be symmetrical and shall conform to the size, age, and condition as specified on the plant list shown in the Contract Documents. Exceptions are as follows:

1. Plants larger than specified in the plant list may be used if approved by the L.A., but use of such plants shall not increase the contract price. If the use of larger plants is approved, the spread of roots or 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 burlaped when required by the L.A.

2. Where caliper or other dimensions of any plant materials are omitted from the Plant List, it shall be understood that such plant materials shall be normal stock for type lit

F. Plants shall be of sound health, vigorous, and free from plant disease and shall be well-branched, shall have full foliage when in leaf, and shall have a healthy well-developed normal root system. Cold storage plants will not be accepted. Plants that are sensitive to shock from elevation change shall be grown at elevations close enough to site to alleviate any plant damage due to such change for at least 2 years.

G. Bare rooted (BR) plants shall have well-developed branch systems and vigorous root systems. They shall be dug to sufficient depth to insure full recovery and development of the plants. Roots of these plants shall be covered with a uniformly thick coating of mud being puddled immediately after they are dug

H. Balled and burlapped (BB) plants shall have firm, natural balls of earth, or diameter not less than that specified and of sufficient depth to include all the fibrous and feeding roots. No plant moved with a ball will be accepted if the ball is cracked or broken before or during plant operations, except on special approval of the L.A.

I. Roots or balls of all plants shall be adequately protected at all times from sun and drying winds.

J. Plants (indicated to be in marked cans, pots, or other containers on the plant list) shall have been grown in the containers for a minimum of 6 months and a maximum of 2 years. Roots shall fill the containers but show no evidence of being or having been root bound.

K. Trees shall have straight trunks and all old abrasions and cuts shall be completely callused over. In no case shall trees be topped before delivery.

L. Plants shall have been transplanted or root-pruned at least once in the 2 years. Plants shall not be pruned prior to delivery except as authorized by the L.A..

2.7 SOD GRASS

A. The sod shall be nursery grown Kentucky Blue grass blend of sod. It shall be uniformly cut approximately 3/4-inch or more thick and shall be well rooted, 2-year old growth of permanent and desirable grasses indigenous to this general location. The sod shall be practically free from weeds and undesirable grasses.

2.8 STAKING MATERIALS

A. Stakes for supporting trees to be metal "T" fence posts or 3" round wood posts.

B. Guying kits for trees will be "Cable Guy" (Alpine Nursery 1-800-356-6633) #CG-4000 and CG-6800-T. Add extra hose where guy cable comes in contact with tree.

C. Hose for covering wire shall be new or used black or green 2-ply fiber-bearing garden hose, not less than ½-inch inside diameter.

D. Wire for tree bracing and guying shall be double strand pliable No. 10-gage galvanized steel wire or vinyl-coated steel wire.

2.9 CONCRETE EDGING

A. Concrete edging per details. Concrete work will conform to on site concrete flat work for quality and workmanship.

2.10 WEED BARRIER FABRIC

A. Weed barrier mat shall be "Dewitt" Weed Barrier Pro 5, "Typar" #3301 or approved equal.

2.11 STONE MULCH & COBBLE ROCK

A. Size and color of stone mulch and cobble as noted on Construction Drawings. Gravel mulches and cobble rock to be washed, clean and uniform in specified size.

PART 3 -- EXECUTION

3.1 GENERAL

A. The landscape work shall not be performed at any time when it may be subject to damage by climatic conditions.

B. The CONTRACTOR shall carefully scale or otherwise verify all dimensions in the Contract Documents. Dimensions and plant locations shown shall be coordinated with L.A. and final location shall be site-oriented by the planter and L.A.. Any discrepancies or inconsistencies discovered shall be brought to the attention of the L.A..

C. In case of conflict between the plant list totals and total plant count of the Contract Documents, the CONTRACTOR shall provide the higher number of plants.

D. Delivery of materials may begin only after samples and tests have been approved by the L.A.. All materials furnished for the work shall be not less than the approved sample.

E. Substitutions for the indicated plant materials may be permitted pursuant to the Contract Documents.

F. The CONTRACTOR shall provide temporary fencing, barricades, covering, or other protections to preserve existing landscaping items indicated to remain and to protect the adjacent properties and other structures when they may be damaged by the landscape work.

G. Waste materials shall be removed and disposed of off the Owner's property, unless otherwise indicated.

H. It shall be the responsibility of the CONTRACTOR to avail itself of any information regarding utilities which are in the area of work and to prevent damage to the same. The CONTRACTOR shall provide protection to the utilities as necessary.

I. Burning of combustible materials on the site shall not be permitted.

J. The CONTRACTOR shall provide protection to structures, sidewalks, pavements, and other facilities in areas of work which are subject to damage during landscape work. Open excavations shall be provide with barricades and warning lights which conform to the requirements of governing authorities and the State's OSHA safety requirements from dusk to dawn each day and when needed for safety.

K. Planting areas include all areas to be landscaped unless, specified or shown, otherwise.

3.2 SOIL PREPARATION

A. The landscape work shall not begin until all other trades have repaired all areas of settlement, erosion, rutting, etc., and the soils have been re-established, recompacted, and refinished to finish grades. The L.A. shall be notified of all areas which prevent the landscape work from being executed.

B. Areas requiring grading by the landscaper including adjacent transition areas shall be uniformly level or sloping between finish elevations to within 0.10-ft above or below required finish elevations.

C. The landscape work shall not proceed until after walks, curbs, pavings, edging, and irrigation systems are in place. The contract operations shall be completed to a point where the landscape areas will not be disturbed. The sub grade shall be cleaned free of waste materials of all kinds.

D. During grading waste materials in the planting areas such as weeds, rocks (2 inches and larger) building materials, rubble, wires, cans, glass, lumber, sticks, etc., shall be removed from the site. Weeds shall be dug out by the roots.

E. Fertilizers, additives, seed, peat, etc. subject to moisture damage shall be kept in a weatherproof storage place in such a manner that they will be kept dry.

F. After removal of waste materials the planting areas sub grade shall be scarified and pulverized to a depth of not less than 6 inches and all surface irregularities below the cover of topsoil removed.

G. Finish sub-grade and topsoil placement and grading shall consist of:

1. Prepare sub-grade by rough grading and removing all irregularities and debris, then till and scarify subsoil to a depth of 6 inches before placing topsoil. Dig sub-grade down as required in shrub beds for the placement of topsoil.

2. Place 4 inches of topsoil over all lawn and 12 inches in shrub beds unless shown or specified otherwise on plans. Sub-grade soil shall be in a loosened and rough surface finish before topsoil is placed over sub-grade. (Sub-grade surface shall not be smooth, but a rough surface shall exist for a transition zone of topsoil to subsoil.) If areas of sub-grade become compacted before topsoil is placed, sub-grade shall be tilled again before topsoil placement..

3. Placing all soil additives and fertilizers.

4. Tilling of lawn and planting areas sub soils and topsoil soils that are compacted.

5. After tilling, bring areas to uniform grades by floating and/or hand raking.

6. Making minor adjustment of finish grades as directed by the L.A or owner.

7. Removing waste materials such as stones, roots, or other undesirable foreign material and raking, dishing, dragging, and smoothing soil ready for planting.

8. No work to be under taken when soils are wet or frozen.

H. Any unusual subsoil condition that will require special treatment shall be reported to the L.A.

I. Topsoil shall be uniformly distributed over all areas where required. Subgrade and topsoil shall be damp and free from frost.

J. Surface drainage shall be provided as shown by molding the surfaces to facilitate the natural run-off of water. Low spots and pockets shall be filled with topsoil and graded to drain properly.

K. Finish grade of all planting areas shall be /2 inches below finish grades of adjacent pavement of any kind for lawn areas.

3.3 DELIVERY, STORAGE, AND HANDLING OF PLANT MATERIALS

A. No plants other than the required samples shall be dug or delivered to the site until the required inspections have been made and the plant samples are approved

B. Plants shall not be pruned prior to delivery except upon approval by the L.A..

C. Plant material shall be planted on the day of delivery if possible. The CONTRACTOR shall protect the stock in a temporary nursery at the project site where it shall be protected from sun and drying winds and shall be shaded, kept moist, and protected with damp soil, moss, or other acceptable material. Plants shall be planted within 2 days after delivery.

D. All balled and burlapped plants which cannot be planted immediately in delivery shall be set on the ground and shall be well protected with soil, wet moss, or other acceptable material. Bare rooted plants, which cannot be planted immediately, shall be planted on heeled-in trenches immediately upon delivery. No material 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.

E. During planting operations, bare roots shall be covered with canvas, wet straw, or other suitable materials. No plants shall be bound with wire or rope at any time so as to damage the bark or break branches.

F. Plants shall not be picked up or moved by stem or branches, but shall be lifted the ball or container.

G. Plants shall be lifted and handled from the bottom of the ball or container. Plants with balls cracked or broken before or during planting operations will not be accepted and shall be immediately removed from the site.

3.4 TREE AND PLANT LOCATIONS

A. The CONTRACTOR shall locate and stake all tree and shrub locations and have the locations approved by the L.A. before starting excavation for same. The plant locations shall be observed, and their locations shall be adjusted as directed by L.A. before final approval.

B. No trees shall be located closer than 72 inches to structures unless otherwise shown. Ground covers and shrubs may be planted up to structures or curbs.

3.5 PLANT PITS

A. Plant pits, centered on location stakes, shall be excavated circular pits with vertical sides and flat or saucer shape bottom in accordance with the following sizes unless shown

1. Tree pits shall be at least 3 feet greater in diameter than the specific diameter of ball or spread of roots, and at depth of ball or roots.

2. Shrubs shall be planted in pits or holes of soil the depth of ball below finished grade, or as much deeper as necessary to properly set the plant at finished grade.. Shrubs with balls shall be planted in pits that are at least 24 inches greater in diameter than the bottom of ball.

3.6 PREPARED BACKFILL

A. Tree and shrub pit backfilling soil shall consist of ½ existing soil from plant pit and ½ top-soil mixed.

B. Tree and shrub pits shall be provided with fertilizer tablets as follows:

1 per one-gallon can plant
3 per 5-gallon can plant
5 per 15-gallon can plant

3.7 ROCKS OR UNDERGROUND OBSTRUCTIONS

A. In the event that rock or underground obstructions are encountered in the excavation of plant pits, alternative locations shall be selected by the L.A.. Moving of trees to alternative locations shall not entail additional costs to the OWNER.

3.8 SETTING PLANT MATERIALS

A. The soil shall not be worked when the moisture content is so great that excessive compaction will occur, nor when it is so dry that a dust will form in the air or that clods will not break readily. Water shall be applied if necessary to provide ideal moisture for filling and for planting as herein specified.

B. Plants shall be set in center of pits as shown in the Contract Documents. They shall be set plumb and straight, and at such a level that after settlement that the crown of the plant will be 2 inches above the finished grade.

C. Balled and burlapped trees shall have planting soil placed and compacted around base of ball to fill all voids. All burlap ropes or wires shall be removed from the sides and tops of balls.

D. All ground cover plants shall be evenly spaced, staggered in rows, and set at intervals specified, so as to produce a uniform effect. Plants shall be watered immediately after Planting operations have been completed.

E. All shrubs and vines shall be pruned to remove damaged branches. All bare root shrubs shall be pruned and shaped to compensate for transplant root loss.

F. Planting soil around roots or balls shall be thoroughly compacted and watered. After planting, the soil in the shrub beds shall be cultivated between shrubs, raked smooth, and neatly outlined. Muddy soil shall not be used for backfilling. All broken or frayed roots shall be properly cut off.

G. Trees and shrubs on slopes steeper than 6 to 1 shall be provided with watering dams or berms at least 6 inches high and 8 inches wider than planting pit (hole) unless specified or shown otherwise.

H. All trees shall be thoroughly watered immediately after planting.

I. Remove all tags and labels when directed by L.A..

3.9 STAKING AND TREE WRAPPING

A. Staking of trees shall be done immediately after they are planted. Plants shall stand plumb after staking. Staking shall be as specified unless shown or indicated otherwise.

B. Trees 2-inch caliper and less shall be supported by 2 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. Trees shall be wired to each stake as indicated on staking details. Trees shall be protected with rubber hose over wires at points of contact.

C. Trees (deciduous) 3-inch caliper and evergreen trees over 6 feet tall to be guyed at points of branching with 3 wire guys spaced equally around and outside the perimeter of the ball with "Cable Guy" product model #CG-4000. Trees over 3-inch caliper to be guyed with "Cable Guy" product CG-6800-T. Each guy shall be positioned below crotches. Provide extra hose cushion where cable comes in contact with tree.

D. Tree wrap trees where noted as follows and for any or all trees that a subject to winter sun and wind damage of the lower trunk:

1. Starting as low as possible, wrap Treesaver in a smooth spiral to assure overlapping each previous wrap by 1/4 inch.
2. Continue wrapping up the trunk to just below the second scaffold branches.
3. Tie of Treesaver with a half hitch knot.
4. Cover the base of tree and the first wrap of Treesaver with soil.

3.10 PRUNING AND MULCHING

A. Each tree and shrub shall be pruned in accordance with standard horticultural practice to preserve the natural character of the plant in the manner fitting its use in the landscape design, as approved by the L.A...

B. All dead wood or suckers and all broken or badly bruised branches shall be removed by thinning out and shortening branches. Deciduous bare-rooted plants shall have not less than 1/3 of their respective leaf surfaces removed. All cuts shall be made just above a healthy bud. Pruning shall be done with clean, sharp tools.

C. Plants shall be mulched after planting and cultivating have been completed. A layer of mulch materials, as hereinbefore specified, shall be spread on finished landscaping grade within all planting areas to a depth as noted on the plan. The mulch around isolated trees shall be 3 feet in diameter. All shrub and ground cover beds shall be completely covered with the mulch.

3.11 SODDING

A. Grass sod shall be provided where shown or specified and shall be maintained.

B. The soil shall be prepared and fertilized before sodding. The CONTRACTOR shall prepare only enough ground that can be planted within 24 hours thereafter.

C. Soil preparation shall consist of the following:

1. Preparation of sub-grade grading shall be per "Part 3 -- Execution" in Paragraphs entitled "General" and "Soil Preparation," herein.

D. Sod shall be cut and laid on site the same day.

E. The sod shall be placed over leveled, compacted, and prepared finish graded soil. The topsoil and sub-base shall be moist enough to resist shifting.

F. Sod may be placed at any time when the ground is not frozen. 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. Sods of the next course are matched against the edge of this first line in such a way the joints between the individual sod pieces in the 2 lines do not coincide. Successive courses are matched against the last line laid, in the same manner.

G. Sod shall always be laid across slopes.

H. After sodding has been completed, the sodded area shall be cleaned up and thoroughly moistened by sprinklers.

I. Soil preparation shall consist of the following:

1. Preparation of sub-grade grading shall be per Paragraphs entitled "General" and "Soil Preparation," respectively, herein.
2. Finish grading of soil per Paragraph entitled "Soil Preparation", herein.

3.12 MISCELLANEOUS ITEMS

A. Gravel mulch and cobble rock shall be placed in the landscape areas as noted on plans, spread carefully and evenly to a minimum depth as noted on plans over weed barrier fabric.

B. Bark mulch shall be placed in the planting areas as shown, spread carefully and evenly to a minimum depth of 4 inches over the entire area.

C. Concrete curbing shall be placed so that the top finish of curbing matches adjoining concrete curbs and walks. Curbing shall be straight and uniform both horizontal and vertically. Where curbing is next to building, curbing shall be placed against the structure with no gaps between structure and curbing.

END OF SECTION 02900

SECTION 03300 - 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 1 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.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.
2. Division 2 Section "Cement Concrete Pavement" for concrete pavement and walks.
3. Division 3 Section "Cast-in-Place Architectural Concrete" for general building applications of specially finished formed concrete.

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. 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.

C. 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.

D. Qualification Data: For installer, manufacturer, testing agency.

E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

F. 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. Curing compounds.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Repair materials.

G. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

H. Field quality-control test and inspection reports.

I. 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. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, 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.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. 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.

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete, "Sections 1 through 5."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Concrete Testing Service: The Owner will engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 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, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, 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. Avoid damaging coatings on steel reinforcement.

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. 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 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. High-density overlay, Class 1 or better.
b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
c. Structural 1, B-B or better; mill oiled and edge sealed.
d. B-B (Concrete Form), Class 1 or better; mill oiled 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. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated Diesel and Kerosene free 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.

F. 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 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) 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. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Deformed-Steel Wire: ASTM A 496.

2.4 REINFORCEMENT ACCESSORIES

A. 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.

2.5 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 II, gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregates: ASTM C 33, 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 (19 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. 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.

2.7 FLOOR AND SLAB TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

1. Available Products:

a. Burke by Edoco; Titan Hard.
b. ChemMasters; Chemisil Plus.
c. ChemTec International; ChemTec One.

d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Intraseal.
e. Curecrete Distribution Inc.; Ashford Formula.
f. Dayton Superior Corporation; Day-Chem Sure Hard.
g. Euclid Chemical Company (The); Euco Diamond Hard.
h. Kaufman Products, Inc.; SureHard.
i. L&M Construction Chemicals, Inc.; Seal Hard.
j. Meadows, W. R., Inc.; Liqui-Hard.
k. Metalcrete Industries; Floorsaver.
l. Nox-Crete Products Group, Kinsman Corporation; Duranox.
m. Symons Corporation, a Dayton Superior Company; Buff Hard.
n. US Mix Products Company; US Spec Industraseal.
o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS.

2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Available 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. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

2.9 RELATED MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. 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.

C. Reglets, where indicated: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet 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 (3.2 mm) 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 (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) 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 (3.2 mm) 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 (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) 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: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 20 percent.

C. 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.

D. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 4 inches (100 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture , plus or minus 1 inch (25 mm).
4. Air Content: 3 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size.

B. Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 inches (100 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture , plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size.

C. Interior Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
2. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).
3. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

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 (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), 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. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm)] for smooth-formed finished surfaces.
2. Class D, 1 inch (25 mm)] for unexposed rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. 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.

F. 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.

G. 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.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. 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." Any misplaced or misaligned anchor rods will require removal and replacement of all concrete attached to anchor rod until all elements are installed correctly
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.

3.3 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 (10 deg C) 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. 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 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

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.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.5 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. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
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. 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 (3.2 mm). 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- (3.2-mm-) 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.

3.6 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. 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 (150 mm) 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.

D. 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.

E. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) 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.

3.7 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. Refer to Section "Architectural Cast-In-Place Concrete".

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.

3.8 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 indicated and to receive concrete floor toppings 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.

1. Apply float finish to surfaces indicated to receive trowel finish.

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) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
b. •

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 indicated and where ceramic or quarry 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.

3.9 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.

3.10 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. Continuous water-fog spray.
    b. 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.

3.11 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

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 qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.
6. Verification of concrete strength before removal of shores and forms from beams and slabs.

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. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
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 mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each truck-load of concrete.
5. 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.
6. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

7. 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.

8. 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.
9. 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 (3.4 MPa).

10. 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.
11. 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.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. 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 (ASTM E 1155M) within 24 hours of finishing.

END OF SECTION 03300

SECTION 03331 - CAST-IN-PLACE 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 specifies cast-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes.

B. Related Sections include the following:

1. Division 2 Section "Cement Concrete Pavement" for concrete pavement and flatwork finishes.
2. Division 3 Section "Cast-in-Place Concrete" for formwork; material, fabrication, and installation requirements for steel reinforcement; and field quality control.
3. Division 7 Section "Joint Sealants" for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.
4. Division 7 Section "Water Repellants" for exposed exterior concrete sealer.

1.3 DEFINITIONS

A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

B. 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.

C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.

D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.4 SUBMITTALS

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

B. 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.

C. Formwork Shop Drawings: Show formwork construction including form-facing joints, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

D. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.

E. Samples: For each of the following materials:

1. Form-facing panel.
2. Form ties.
3. Form liners.
4. Chamfers and rustications.

F. Qualification Data: For manufacturer and testing agency.

G. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

H. Material Certificates: For each of the following, signed by manufacturer:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Repair materials.

I. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. 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.

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.
2. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency

laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Source Limitations for Cast-in-Place Architectural Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from one manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete", Sections 1 through 5 and Section 6, "Architectural Concrete."
2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Mockups: Before casting architectural concrete, build mockups to verify selections made under sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. 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. Build mockups of typical exterior wall of cast-in-place architectural concrete as shown on Drawings.
3. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
4. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
5. Obtain Architect's approval of mockups before casting architectural concrete.
6. 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."

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 architectural 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. Cast-in-place architectural concrete subcontractor.

2. Review concrete finishes and finishing, hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural concrete.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for formwork and other form-facing material requirements.

B. Form-Facing Panels for As-Cast Finishes: Steel, glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that will provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

C. Form-Facing Panels for As-Cast Finishes: Exterior-grade panels, nonabsorptive, that will provide continuous, true, and smooth architectural concrete surfaces, high-density overlay, Class 1, or better, mill-applied release agent and edge sealed, complying with DOC PS 1, or Finnish phenolic overlaid birch plywood.

D. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch (19 by 19 mm) minimum, or as detailed on drawings; nonstaining; in longest practicable lengths.

E. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or S, Grade NS, that adheres to form joint substrates.

F. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

G. Form-Release Agent: Commercially formulated colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials. Form release to be Diesel and Kerosene free, premium reactive form release, as outlined in Section 03300 : Cast-In-Place Concrete.

H. Surface Retarder: Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.

I. Form Ties: Factory-fabricated, internally disconnecting or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish ties with tapered tie cone spreaders that, when removed, will leave holes 3/4 inch (19 mm) in diameter on concrete surface.

2.2 STEEL REINFORCEMENT AND ACCESSORIES

A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."

1. Where legs of wire bar supports contact forms, use gray, all-plastic or CRSI Class 2, stainless-steel bar supports.

2.3 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 II, gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
c. Silica Fume: ASTM C 1240, amorphous silica.

2. Blended Hydraulic Cement: ASTM C 595, Type I (PM), pozzolan-modified portland cement.

B. Normal-Weight Aggregates: ASTM C 33, 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 (19 mm).
2. Gradation: Uniformly graded.

C. Normal-Weight Fine Aggregate: ASTM C 33, manufactured or natural sand, from same source for entire Project.

D. Water: Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

2.4 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. Color Pigment where indicated: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Color: As selected by Architect from manufacturer's full range.

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. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

1. For integrally colored concrete, curing compound shall be approved by color pigment manufacturer.
2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

2.6 REPAIR MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

B. 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.

1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on 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 design mixtures based on laboratory trial mixtures.

B. Proportion concrete mixtures as outlined in Section 03300, "Cast-In-Place Concrete".

C. Cementitious Materials: For cast-in-place architectural concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXING

A. Ready-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
2. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for formwork, embedded items, and shoring and reshoring.

B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.

C. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm).

D. Fabricate forms to result in cast-in-place architectural concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.

1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
2. Do not use rust-stained steel form-facing material.

F. 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.

G. Chamfer exterior corners and edges of cast-in-place architectural concrete.

H. Coat contact surfaces of wood chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

M. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.

N. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.2 REINFORCEMENT AND INSERTS

A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.

B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.3 REMOVING AND REUSING FORMS

A. 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 (10 deg C) 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. Schedule form removal to maintain surface appearance that matches approved mockups.

B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved 70 percent of 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.

D. 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 cast-in-place architectural concrete surfaces.

3.4 JOINTS

A. Construction Joints: Install construction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete 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.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete. Align construction joint within rustications attached to form-facing material.
3. 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.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

B. Contraction Joints: Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, form-release agent, 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 between construction joints. 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 303.1.
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 (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.

E. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) 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.

3.6 FINISHES, GENERAL

A. Architectural Concrete Finish: Provide architectural grade concrete largely free of minor bug holes and totally free of honey-combing, with a smooth-formed finished surface, to satisfaction of Architect. All bug holes larger than ¼" diameter to be filled as directed by architect.

B. 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.

1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

C. Maintain uniformity of special finishes over construction joints, unless otherwise indicated.

3.7 AS-CAST FORMED FINISHES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Do not repair and patch tie holes and defects, unless directed by architect after visual inspection during form removal.

B. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete where directed by architect after visual inspection during form removal:
1. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match surrounding concrete. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3.8 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 with ACI 301 for hot-weather protection during curing.

B. Begin curing cast-in-place architectural concrete immediately after removing forms from concrete and applying as-cast formed finishes to concrete according to architect's

instructions. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:

1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural concrete 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; use cover material and waterproof tape.
3. Curing Compound: Mist concrete surfaces with water. Apply curing compound 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 FIELD QUALITY CONTROL

A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for field quality-control requirements.

3.10 REPAIRS, PROTECTION, AND CLEANING

A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.

   1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.

B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.

C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.

D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

E. Wash and rinse surfaces according to concrete finish applicator's written recommendations. Protect other Work from staining or damage due to cleaning operations.

   1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes or adjacent finishes or existing natural materials.

END OF SECTION 03331

SECTION 03450 - ARCHITECTURAL PRECAST 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. Architectural precast concrete cladding units.
2. Architectural precast concrete site accessories.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for installing connection anchors in concrete.
2. Division 4 Section "Unit Masonry Assemblies" for precast concrete sills built into masonry walls.
3. Division 5 Section "Structural Steel" for furnishing and installing connections attached to structural-steel framing.
4. Division 5 Section "Metal Fabrications" for kickers and other miscellaneous steel shapes.

1.3 DEFINITION

A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Loads: As indicated.
2. Dead Loads: As indicated.
3. Live Loads: As indicated.
4. Wind Loads: As indicated.
5. Seismic Loads: As indicated.
6. Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:

    a. Upward and downward movement of 3/4 inch (19 mm).

7. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F (67 deg C).
8. Vehicular Impact Loads, for panels exposed to the exterior: Design spandrel beams acting as vehicular barriers for passenger cars to resist a single 6000-lb (26.7-kN) service load and 10,000-lb (44.5-kN) ultimate load applied horizontally in any direction to the spandrel beam, with anchorages or attachments capable of transferring this load to the structure. Design spandrel beams assuming the load to act at a height of 18 inches (460 mm) above the floor or ramp surface on an area not to exceed 1 sq. ft. (0.93 sq. m).

1.5 SUBMITTALS

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

B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

C. Shop Drawings: Detail fabrication and installation of architectural precast concrete units as required to match existing adjacent panels. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.

1. Indicate separate face and backup mixture locations and thicknesses.
2. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
3. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
4. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
5. Include plans and elevations showing unit location and sequence of erection for special conditions.
6. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
7. Indicate relationship of architectural precast concrete units to adjacent materials.
8. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
9. Comprehensive engineering analysis signed and sealed by the qualified professional engineer, licensed in the State of Utah, responsible for its preparation. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

D. Samples: For each type of finish indicated on exposed surfaces of architectural precast 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).

1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.

a. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.

b. Grout Samples for Verification: Showing color and texture of joint treatment.

E. Welding certificates.

F. Qualification Data: For Installer, fabricator, testing agency.

G. Material Test Reports: For aggregates.

H. Material Certificates: For the following items, signed by manufacturers:

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Structural-steel shapes and hollow structural sections.

I. Source quality-control test reports.

J. Field quality-control test and special inspection reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance to erect Category A (Architectural Systems) for non-load-bearing members.

B. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

D. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

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. Welding: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel."

G. Calculated Fire-Test-Response Characteristics: Where indicated, provide architectural precast concrete units whose fire resistance has been calculated according to ACI 216.1/TMS 0216.1, "Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies," or PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete," and is acceptable to authorities having jurisdiction.

H. Sample Panels: After sample approval and before fabricating architectural precast concrete units, produce a sample panel for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels as required to match existing panels.

1. Locate panels where indicated or, if not indicated, as directed by Architect.
2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
3. After acceptance of repair technique, maintain one sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
4. Demolish and remove sample panels when directed.

I. Range Samples: After sample panel approval and before fabricating architectural precast concrete units, produce a minimum of 2 sets of samples, representing anticipated range of each color and texture on Project's units, and matching existing panels. Following range sample, maintain one set of samples at Project site and remaining sample sets at manufacturer's plant as color and texture approval reference.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.

B. Support units during shipment on nonstaining shock-absorbing material.

C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

D. Place stored units so identification marks are clearly visible, and units can be inspected.

E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.

F. Lift and support units only at designated points shown on Shop Drawings.

1.8 SEQUENCING

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fabricators: Subject to compliance with requirements, provide products by one of the following, or approved equal:

1. Eagle Precast, 6087 West 5400 South, Salt Lake City, Utah 84118, (801) 966-1060.
2. Modern Precast, 370 West 1550 South, Salt Lake City, Utah 84115, (801) 466-1374.
3. Approved equal.

2.2 Products

A. Precast concrete window sills, as indicated.

B. Precast concrete window lintels, as indicated.

C. Precast concrete vehicle barriers, as indicated.

D. Precast concrete splash blocks, as indicated.

2.3 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

B. Form Liners: Units of face design, texture, arrangement, and configuration to match existing precast concrete panels. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.4 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

C. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.5 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin Admixture: ASTM C 618, Class N.
3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.

D. 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.

E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: 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. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017 M.

2.6 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates, where indicated: ASTM A 36/A 36M.

B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

C. Carbon-Steel Plate: ASTM A 283/A 283M.

D. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.

E. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.

F. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.

G. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563 (ASTM A 563M); and flat, unhardened steel washers, ASTM F 844.

H. High-Strength Bolts and Nuts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563 (ASTM A 563M); and hardened carbon-steel washers, ASTM F 436 (ASTM F 436M).

I. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.

1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

J. 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 MPI 79 or SSPC-Paint 25 according to SSPC-PA 1.

K. Welding Electrodes: Comply with AWS standards.

2.7 BEARING PADS

A. Provide one of the following bearing pads for architectural precast concrete units, where indicated or as recommended by precast fabricator for application:

1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, Type A durometer hardness of 50 to 70, ASTM D 2240, minimum tensile strength 2250 psi (15.5 MPa), ASTM D 412.
2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Type A durometer hardness of 70 to 90, ASTM D 2240; capable of supporting a compressive stress of 3000 psi (20.7 MPa) with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
3. Frictionless Pads: Tetrafluoroethylene (Teflon), glass-fiber reinforced, bonded to stainless or mild-steel plate, of type required for in-service stress.
4. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.8 ACCESSORIES

A. Precast Accessories, as required: Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.9 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144, or ASTM C 404. 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, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.

C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

2.10 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

1. Limit use of fly ash and silica fume to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.

D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures 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) minimum.
2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: 6 percent by weight or 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 mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.11 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 and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.

B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces exposed to view in the finished work.
2. Edge and Corner Treatment: As required to match existing.

2.12 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.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in openings larger than 10 inches (250 mm) in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.

D. Reinforcement: Comply with recommendations in 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. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
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 spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.

F. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

G. Place face mixture 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 specified.

H. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.

1. Place backup concrete mixture to ensure bond with face-mixture concrete.

I. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.

1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

J. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

K. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.

L. 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. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

M. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.13 FABRICATION TOLERANCES

A. Fabricate architectural precast 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:

1. 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).
b. 10 to 20 feet (3 to 6 m), plus 1/4 inch (6 mm), minus 3/8 inch (10 mm).
c. 20 to 40 feet (6 to 12 m), plus or minus 3/8 inch (10 mm).
d. Each additional 10 feet (3 m), plus or minus 1/8 inch (3 mm).

2. Total Thickness or Flange Thickness: Plus 1/4 inch (6 mm), minus 1/8 inch (3 mm).
3. Rib Thickness: Plus or minus 1/8 inch (3 mm).
4. Rib to Edge of Flange: Plus or minus 1/8 inch (3 mm).
5. Distance between Ribs: 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 1830 mm) or 1/2 inch (13 mm) total, whichever is greater.
7. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/4 inch (6 mm).
8. Dimensions of Haunches: Plus or minus 1/4 inch (6 mm).
9. Haunch Bearing Surface Deviation from Specified Plane: Plus or minus 1/8 inch (3 mm).
10. Difference in Relative Position of Adjacent Haunch Bearing Surfaces from Specified Relative Position: Plus or minus 1/4 inch (6 mm).
11. Bowing: Plus or minus L/360, maximum 1 inch (25 mm).
12. Local Smoothness: 1/4 inch per 10 feet (6 mm per 3 m).
13. Warping: 1/16 inch per 12 inches (1.5 mm per 300 mm) of distance from nearest adjacent corner.
14. Tipping and Flushness of Plates: Plus or minus 1/4 inch (6 mm).
15. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch (3 mm).

B. 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. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch (13 mm) of plan dimensions.
6. Location of Opening within Panel: Plus or minus 1/4 inch (6 mm).
7. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch (13 mm).
8. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch (6 mm).
9. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: 2-degree rotation or 1/4 inch (6 mm) maximum over the full dimension of unit.
10. Position of Sleeve: Plus or minus 1/2 inch (13 mm).

2.14 FINISHES

A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match sample panels and as follows:

1. As-Cast Surface Finish: Provide surfaces free of pockets, sand streaks, and honeycombs.

B. Finish exposed surfaces of architectural precast concrete units to match face-surface finish.

C. Finish unexposed surfaces of architectural precast concrete units by float finish.

2.15 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6,

"Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

B. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.

1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
2. Cores will be tested in an air-dry condition.
3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
4. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:

    a. Project identification name and number.
    b. Date when tests were performed.
    c. Name of precast concrete fabricator.
    d. Name of concrete testing agency.
    e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

C. 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 mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Do not install precast concrete units until supporting cast-in-place building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is complete.

3.2 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch (19 mm).

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- (0.1-mm-) thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
4. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
5. Remove, reweld, or repair incomplete and defective welds.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.

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. Erect architectural precast 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. Non-Exposed Individual Panel: Plus or minus 1/2 inch (13 mm).
    c. Exposed Panel Relative to Adjacent Panel: 1/4 inch (6 mm).
    d. Non-Exposed 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).
13. Opening Height between Spandrels: Plus or minus 1/4 inch (6 mm).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Repair or remove and replace work where tests and inspections 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.

3.5 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.6 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. 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 or damage adjacent materials.

END OF SECTION 03450

SECTION 04810 - 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. Concrete masonry units (CMUs).
2. Decorative concrete masonry units.
3. Mortar and grout.
4. Reinforcing steel.
5. Miscellaneous masonry accessories.
6. Masonry-cell insulation.

B. Related Sections include the following:

1. Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements" for waste masonry recycling and regional material procurement requirements and documentation.
2. Division 3 Section "Architectural Precast Concrete" for precast concrete trim set into CMU construction.
3. Division 7 Section "Water Repellents" for water repellents applied to unit masonry assemblies.
4. Division 7 Section "Sheet Metal Flashing and Trim" for exposed sheet metal copings and flashing.
5. Division 7 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.
6. Division 15 Sections for wall louvers and vents.

C. Products furnished, but not installed, under this Section include the following:

1. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 5 Section "Structural Steel."

D. Products installed, but not furnished, under this Section include the following:

1. Precast-concrete trim, furnished under Division 3 Section "Architectural Precast Concrete."

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths (f'_m) at 28 days.

B. Determine net-area compressive strength (f'_m) of masonry by testing masonry prisms according to ASTM C 1314.

1.5 SUBMITTALS

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

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection: For the following:

1. Decorative, integrally colored, concrete masonry units, in the form of small-scale units.
2. Integrally colored, smooth face units, in the form of small-scale units.
3. Colored mortar, where indicated.

D. Samples for Verification: For each type and color of the following:

1. Decorative integrally colored concrete masonry units.
2. Integrally colored smooth face units.
3. Colored mortar, where indicated. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
4. Accessories embedded in masonry.

E. 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 Architect and approved in writing.

F. Qualification Data: For testing agency.

G. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.

b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Grout mixes. Include description of type and proportions of ingredients.
4. Reinforcing bars.
5. Anchors, ties, and metal accessories.

H. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

I. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

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. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for 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 a single 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 other means, as acceptable to authorities having jurisdiction.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 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.

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. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

A. Protection of Masonry: During 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 (600 mm) down both sides and hold cover securely in place.

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 spreading coverings 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. 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.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

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. 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 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 CONCRETE MASONRY UNITS (CMUs)

A. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners, unless otherwise indicated.

B. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
2. Weight Classification: Lightweight, unless otherwise indicated.
3. Size (Width): 8 inches or as indicated, Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample, or selected from manufacturer's full range.

C. Decorative Concrete Masonry Units, where indicated: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
2. Weight Classification: Lightweight, unless otherwise indicated.
3. Size (Width): Manufactured to dimensions specified in "Concrete Masonry Units" Paragraph above.
4. Pattern and Texture:

a. Standard pattern, split-face finish.

5. Colors: As selected by Architect from manufacturer's full range.
6. Available Products:

    a. Amcor Masonry Products
    b. Buehner Block Co.
    c. Lehi Block Co.
    d. Approved equal.

2.4 MASONRY LINTELS

A. General: Provide masonry lintels, complying with requirements below.

B. Masonry Lintels, where indicated: Built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintels until cured.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.

D. Mortar Pigments, where indicated: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Available Products:

    a. Bayer Corporation, Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
    b. Davis Colors; True Tone Mortar Colors.
    c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.

E. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Available Products:

    a. Addiment Incorporated; Mortar Kick.
    b. Euclid Chemical Company (The); Accelguard 80.
    c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.

d. Sonneborn, Div. of ChemRex; Trimix-NCA.

G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

1. Available Products:

a. Addiment Incorporated; Mortar Tite.
b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
c. Master Builders, Inc.; Color Cure Mortar Admix or Rheomix Rheopel.

H. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with Division 7 Section "Sheet Metal Flashing and Trim".
1. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.6 m). Provide splice plates at joints of formed, smooth metal flashing.
2. Fabricate through-wall metal flashing embedded in masonry from stainless steel or copper, with ribs at 3-inch (75-mm) intervals along length of flashing to provide an integral mortar bond.

a. Available Products:

1) Cheney Flashing Company; Cheney Flashing Dovetail) or Cheney 3-Way Flashing (Sawtooth).
2) Keystone Flashing Company, Inc.; Keystone 3-Way Interlocking Thruwall Flashing.

3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
4. Fabricate through-wall flashing with drip edge, unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.

B. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch (0.8 mm).

a. Available Products:

1) Advanced Building Products Inc.; Peel-N-Seal.
2) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
3) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier-44.
4) Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
5) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
6) Hohmann & Barnard, Inc.; Textroflash.
7) Polyguard Products, Inc.; Polyguard 300.
8) Polytite Manufacturing Corp.; Poly-Barrier Self-Adhering Wall Flashing.
9) Williams Products, Inc.; Everlastic MF-40.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Division 7 Section "Sheet Metal Flashing and Trim."

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use one of the following, unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from UV-resistant synthetic fiber, 1/4 to 3/8 inch (6 to 10 mm) in diameter, in length required to produce 2-inch (50-mm) exposure on exterior and 18 inches (450 mm) in cavity between wythes. Use only for weeps.
2. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch (9-mm) OD by 4 inches (100 mm) long.
3. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches (9 by 38 by 89 mm) long.
4. 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.

a. Available Products:

1) Advanced Building Products Inc.; Mortar Maze weep vent.
2) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
3) Heckmann Building Products Inc.; No. 85 Cell Vent.
4) Hohmann & Barnard, Inc.; Quadro-Vent.

5) Wire-Bond; Cell Vent.

5. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, 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.

a. Available Products:

1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.
2) Approved equal.

E. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch (3.6-mm) steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.

1. Available Products:

a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.9 MASONRY-CELL INSULATION

A. Loose-Granular Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

2.10 MASONRY CLEANERS

A. 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 Manufacturers:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. 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.
2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.

3. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement, mortar cement, and lime. Add water-repellent admixture as indicated.
4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix, at contractor's option: Furnish dry mortar ingredients in 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. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For reinforced masonry, use Type S.

D. Pigmented Mortar, where indicated: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
3. Mix to match Architect's sample.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in 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 (200 to 280 mm) as measured according to ASTM C 143/C 143M.

F. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

2.12 SOURCE QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to perform source quality-control testing indicated below:

1. Payment for these services will be made by Owner.
2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

B. Concrete Masonry Unit Test: For each type of unit furnished, per ASTM C 140.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry, where occurs: Match coursing, bonding, color, and texture of existing masonry.

G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), maximum.
2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m) maximum.
3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m) maximum.
4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.3 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: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

G. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

H. 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. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c., unless otherwise indicated.
3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 7 Section "Fire-Resistive Joint Systems."

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.

4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry or precast concrete units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

3.5 MASONRY-CELL INSULATION

A. Pour granular insulation into cavities to fill void spaces. Maintain inspection ports to show presence of insulation at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of insulation to 1 story in height, but not more than 20 feet (6 m).

3.6 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. Provide horizontal, pressure-relieving joints by either leaving an air space or 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.

3.7 LINTELS

A. Provide masonry lintels where shown and where openings of more than 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb, unless otherwise indicated.

3.8 FLASHING, WEEP HOLES, CAVITY DRAINAGE, 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. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, 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.
2. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.
4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.
5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install nailers for flashing and other related construction where they are shown to be built into masonry.

E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products or open head joints to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches (600 mm) o.c., unless otherwise indicated.
4. Space weep holes formed from plastic tubing or wicking material 16 inches (400 mm) o.c.
5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

6. Trim wicking material flush with outside face of wall after mortar has set.

F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (50 mm), to maintain drainage.

3.9 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602 .

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.10 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:

1. Payment for these services will be made by Owner.
2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

C. Testing Frequency: One set of tests for each 5000 sq. ft. (465 sq. m) of wall area or portion thereof.

D. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.

E. Mortar Test (Property Specification): For each mix provided, per ASTM C 780.

F. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019 .

G. Prism Test: For each type of construction provided, per ASTM C 1314 at 7 days and at 28 days.

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, where indicated.

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 stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
7. Clean precast concrete trim to comply with precast supplier's written instructions.

3.12 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site. Refer to Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements" for specific requirements regarding masonry recycling and disposal.

END OF SECTION 04810

SECTION 05120 - STRUCTURAL STEEL

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. Structural steel.
2. Grout.

B. Related Sections include the following:

1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements" for salvaging structural steel waste, recycled material content and regional procured materials requirements.
3. Division 5 Section "Steel Deck" for field installation of shear connectors.
4. Division 5 Section "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
5. Division 9 painting Sections for surface preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.4 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand LRFD loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC's "Manual of Steel Construction, Load and Resistance Factor Design," Volume 2, Part 9 .

1.5 SUBMITTALS

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

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.

C. Welding certificates.

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

E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Direct-tension indicators.
4. Tension-control, high-strength bolt-nut-washer assemblies.
5. Shop primers.
6. Nonshrink grout.

F. Source quality-control test reports.

G. Recycled material content documentation for meeting Owners "SPiRiT" Sustainable Design Requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, and is approved by local jurisdiction.

B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, and is approved by local jurisdiction.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

E. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."
3. AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings."
4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
5. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

F. Mockups: Build mockups of architecturally exposed structural steel to set quality standards for fabrication and installation.

1. Coordinate finish painting requirements with Division 9 painting Sections.

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 to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W Shapes: ASTM A 992 (Fy = 50 ksi).

B. Angles: ASTM A 36/A 36M (galvanized exterior steel).

C. Plate and Bar: ASTM A 572/A 572M, Grade 50 (345) (galvanized exterior steel).

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing (galvanized exterior steel).

E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B (galvanized exterior steel).

1. Weight Class: Double-extra strong.
2. Finish: Black (galvanized exterior steel).

F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.

1. Finish: Plain (Hot-dip zinc coating for exterior use).
2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8,) compressible-washer type.

    a. Finish: Plain (Hot-dip zinc coating for exterior use).

B. Unheaded Anchor Rods: ASTM F 1554, Grade .

1. Configuration: Hooked.
2. Nuts: ASTM A 563 (ASTM A 563M) heavy hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
5. Finish: Plain (hot-dip zinc coating for exterior use).

C. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
4. Finish: Plain (hot-dip zinc coating for exterior use).

D. Threaded Rods: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6).

1. Nuts: ASTM A 563 (ASTM A 563M) heavy hex carbon steel.
2. Washers: ASTM F 436 (ASTM F 436M) hardened] [ASTM A 36/A 36M carbon steel.
3. Finish: Plain for interior use, Hot-dip zinc coating for exterior use, ASTM A 153/A 153M, Class C.

E. Clevises, Turnbuckles: ASTM A 108, Grade 1035, cold-finished carbon steel.

F. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

G. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.3 PRIMER

A. Primer: SSPC-Paint 25, Type I, iron oxide, zinc oxide, raw linseed oil, and alkyd (interior structural steel).

B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer (exterior structural steel).

C. Galvanizing Repair Paint: ASTM A 780 (exterior structural steel).

2.4 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.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."

1. Camber structural-steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

F. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

G. Welded Door Frames, where indicated: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches (250 mm) o.c., unless otherwise indicated.

H. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened, except as otherwise noted.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.

    a. Grind butt welds flush.
    b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials.
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).Coordinate with Division 9 Section "Painting" for primer and finish coatings compatibility requirements.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish for all exterior steel and fasteners: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.

1. Fill vent holes and grind smooth after galvanizing.

2.9 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Load and Resistance Factor Design Specification for Structural Steel Buildings."

B. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base plates. Clean bottom surface of base plates.

1. Set base plates for structural members on wedges, shims, or setting nuts as required.
2. Snug-tighten anchor rods 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 before packing with grout.
3. Promptly pack grout solidly between bearing surfaces and base plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Do not use thermal cutting during erection. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened, except as noted otherwise.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Load and Resistance Factor Design Specification for Structural Steel Buildings" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.

    a. Grind butt welds flush.
    b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E 165.
    b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    c. Ultrasonic Inspection: ASTM E 164.
    d. Radiographic Inspection: ASTM E 94.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.

END OF SECTION 05120

SECTION 05210 - STEEL JOISTS

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. LH Series steel joists.
2. K-series steel joists.
3. Joist accessories.

B. Related Sections include the following:

1. Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements" for salvaging waste steel materials, recycled material content and regionally procured materials requirements.
2. Division 3 Section "Cast-in-Place Concrete" for installing bearing plates in concrete.
3. Division 4 Section "Unit Masonry Assemblies" for installing bearing plates in unit masonry.

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.

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. Welding certificates.

D. Manufacturer Certificates: Signed by manufacturers certifying that joists comply with requirements.

E. Mill Certificates: Signed by bolt manufacturers certifying that bolts comply with requirements.

F. Qualification Data: For manufacturer and professional engineer.

G. Field quality-control test and inspection reports.

H. Research/Evaluation Reports: For joists.

I. Recycled material content documentation for meeting Owners "SPiRiT" Sustainable Design Requirements.

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.

1.8 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel: Comply with SJI's "Specifications" for web and steel-angle chord members.

B. Steel Bearing Plates: ASTM A 36/A 36M.

C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated and Hot-dip zinc coating, ASTM A 153/A 153M, Class C for exterior steel.

D. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.

1. Finish: Plain, uncoated and Hot-dip zinc coating, ASTM A 153/A 153M, Class C for exterior steel.

E. Welding Electrodes: Comply with AWS standards.

F. Galvanizing Repair Paint: SSPC-Paint 20.

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 9 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. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

D. Provide holes in chord members for connecting and securing other construction to joists.

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 (1:48).

2.4 JOIST ACCESSORIES

A. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates with integral anchorages of sizes and thicknesses indicated. Shop prime paint, (Hot-dip zinc coat according to ASTM A 123/A 123M for exterior steel).

C. Steel bearing plates with integral anchorages are specified in Division 5 Section "Metal Fabrications."

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 (13 mm) 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 hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. 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 (0.025 mm) thick.

D. Shop priming of joists and joist accessories is specified in Division 9 painting Sections.

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 bearing plates and 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 carbon-steel bolts.

E. 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.

F. 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. In addition to visual inspection, field welds will be tested according to AWS D1.1/D1.1M and the following procedures, as applicable:

1. Magnetic Particle Inspection: ASTM E 709.
2. Ultrasonic Testing: ASTM E 164.
3. Liquid Penetrant Inspection: ASTM E 165.

D. Bolted connections will be visually inspected.

E. 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."

F. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

G. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. 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.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.

D. 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 05210

SECTION 05310 - STEEL DECK

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 deck.
2. Composite floor deck.

B. Related Sections include the following:

1. Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements" for salvaging waste steel, recycled material content and regionally procured materials requirements.
2. Division 3 Section "Cast-in-Place Concrete" for concrete fill.
3. Division 5 Section "Structural Steel" for shop- and field-welded shear connectors.
4. Division 5 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
5. Division 9 painting Sections for repair painting of primed deck.

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. 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.

C. Product Certificates: For each type of steel deck, signed by product manufacturer.

D. Welding certificates.

E. Field quality-control test and inspection reports.

F. 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.

G. Research/Evaluation Reports: For steel deck.

H. Recycled material content documentation for meeting Owners "SPiRiT" Sustainable Design Requirements.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. 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.

D. 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."

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. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

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:

B. 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), zinc coating.
2. Deck Profile: As indicated, Type WR, wide rib.
3. Profile Depth: As indicated, 1-1/2 inches (38 mm).
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: Triple span or more.
6. Side Laps: Interlocking seam.

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 and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard gray baked-on, rust-inhibitive primer.
2. Profile Depth: 2 inches (50 mm).
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. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 30 for overhang and slab depth, unless otherwise indicated .

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and level recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.

J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

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 or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:

1. Weld Diameter: 3/4 inch (19 mm), nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals as indicated.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) 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 (305 mm) apart with at least one weld at each corner.

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.

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: 3/4 inch (19 mm), nominal.
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, at intervals not exceeding the lesser of half of the span or 36 inches (910 mm), and as follows:

1. Mechanically clinch or button punch.
2. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches (50 mm) , 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 (355 mm) apart in both directions, within 9 inches (228 mm) of walls at ends, and not more than 12 inches (305 mm) 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 prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Division 9 Section "Painting."

D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05310

SECTION 05400 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Exterior non-load-bearing curtain-wall framing.

B. Related Sections include the following:

1. Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements" for salvaging waste steel, recycled material content and regionally procured materials requirements.
2. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
3. Division 6 Section "Sheathing" for exterior plywood wall sheathing and air-infiltration barriers.
4. Division 7 Section "Building Insulation" for batt insulation and vapor barrier.
5. Division 9 Section "Gypsum Board Assemblies" for interior gypsum board wall finish.

1.3 DEFINITIONS

A. Minimum Uncoated Steel Thickness: Minimum uncoated thickness of cold-formed framing delivered to the Project site shall be not less than 95 percent of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.

B. Producer: Entity that produces steel sheet coil fabricated into cold-formed members.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

a. Exterior Non-Load-Bearing Curtain-Wall Framing: Horizontal deflection of 1/240 of the wall height.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

    a. Upward and downward movement of 1/2 inch (13 mm).

B. Design exterior non-load-bearing curtain-wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Design roof trusses according to AISI's "Design Guide for Cold-Formed Steel Trusses."

1.5 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency indicating steel sheet complies with requirements.

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.

F. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:

1. Expansion anchors.
2. Power-actuated anchors.
3. Mechanical fasteners.
4. Vertical deflection clips.
5. Miscellaneous structural clips and accessories.

G. Research/Evaluation Reports: Evidence of cold-formed metal framing's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

H. Recycled material content documentation for meeting Owners "SPiRiT" Sustainable Design Requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed cold-formed metal framing 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. Engineering Responsibility: Engage a qualified professional engineer to prepare design calculations, Shop Drawings, and other structural data.

C. 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 cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

D. Mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency indicating steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and galvanized-coating thickness.

E. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

F. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

G. Fire-Test-Response Characteristics: Where metal framing is part of a fire-resistance-rated assembly, provide 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.

1. Fire-Resistance Ratings: Indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual," or by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

H. AISI Specifications: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" or "Load and Resistance Factor Design Specification for Cold-Formed Steel Structural Members" and the following for calculating structural characteristics of cold-formed metal framing:

1. CCFSS Technical Bulletin: "AISI Specification Provisions for Screw Connections."

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.7 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. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:

1. Allied American Studco, Inc.
2. Angeles Metal Systems.
3. California Metal Systems, Inc.
4. Clark Steel Framing Industries.
5. Consolidated Fabricators Corp.
6. Consolidated Systems, Inc.
7. Dale Industries, Inc.
8. Design Shapes in Steel.
9. Dietrich Industries, Inc.
10. Knorr Steel Framing Systems.
11. MarinoWare; Div. of Ware Industries, Inc.
12. Scafco Corp.
13. Steel Construction Systems.
14. Steel Developers, LLC.
15. Steeler, Inc.
16. Studco of Hawaii, Inc.
17. Super Stud Building Products, Inc.
18. Unimast, Inc.
19. United Metal Products, Inc.
20. Approved equal.

2.2 MATERIALS

A. Steel Sheet: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
1. Grade: 33 (230) for minimum uncoated steel thickness of 0.0428 inch (1.09 mm) and less; 50 (340), Class 1 or 2 for minimum uncoated steel thickness of 0.0538 inch (1.37 mm) and greater.
2. Coating: G60 (Z180).

2.3 NON-LOAD-BEARING CURTAIN-WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, complying with ASTM C 955, and as follows:

1. Minimum Uncoated-Steel Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, complying with ASTM C 955, and as follows:

1. Minimum Uncoated-Steel Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches (32 mm).

C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads, and as follows:.

1. Minimum Uncoated-Steel Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: A minimum of 2 inches (50 mm).

D. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure.
1. Flange Width: 1-5/8 inches (41 mm),

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi (230 MPa).

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. End clips.
5. Foundation clips.
6. Gusset plates.
7. Stud kickers, knee braces, and girts.
8. Joist hangers and end closures.
9. Hole reinforcing plates.
10. 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.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel, hex-headed, hooked headless with encased end threaded, bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. 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.

D. 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.

E. Mechanical Fasteners: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. 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.

D. Thermal Insulation: ASTM C 665, Type I, unfaced mineral-fiber blankets produced by combining glass or slag fibers with thermosetting resins.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations 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. Wire tying of framing members is not permitted. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
4. Fasten cold-formed metal framing members by welding or screw fastening, 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.

5. 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 (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) 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 (3 mm).

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. 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. Grout bearing surfaces uniform and level to ensure full contact of bearing flanges or track webs on supporting concrete or masonry construction.

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 ASTM C 1007, unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. 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 (1.6 mm).

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding or screw fastening, 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.

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 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 (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 NON-LOAD-BEARING CURTAIN-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: 16 inches (406 mm).

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 deep-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 primary building structure.

E. Install horizontal bridging in curtain-wall studs, spaced in rows indicated on Shop Drawings but not more than 54 inches (1370 mm) apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (300 mm) of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

a. Install solid blocking at centers indicated.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

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 curtain-wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing agency to perform field quality-control testing.

B. Field and shop welds will be subject to inspection and testing.

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.

3.6 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. Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on fabricated and installed prime-painted, cold-formed metal framing. Paint framing surfaces with same type of shop paint used on adjacent surfaces.

C. Protect paper-surfaced gypsum sheathing that will be exposed to weather for more than 30 days by covering exposed exterior surface of sheathing with a securely fastened air-infiltration barrier. Apply covering immediately after sheathing is installed.

D. Protect cutouts, corners, and joints in sheathing by filling with a flexible sealant or by applying tape recommended by sheathing manufacturer at time sheathing is applied.

E. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05400

SECTION 05500 - 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 framing and supports for countertops.
2. Steel framing and supports for ceiling-hung toilet compartments.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Steel weld plates and angles for casting into concrete not specified in other Sections.
6. Steel fabricated and galvanized exterior window shade louvers.
7. Steel framing and supports for operable partitions.
8. Steel framing and supports for overhead doors.
9. Elevator machine beams, hoist beams, and divider beams.
10. Support angles for elevator door sills.
11. Bent plates.
12. Loose bearing and leveling plates.
13. Metal ladders.
14. Bollards.
15. Bicycle racks.
16. Abrasive metal nosings.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete.
2. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Sections include the following:

1. Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements" for salvaging waste steel, recycled material content and regionally procured materials requirements.
2. Division 3 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items indicated to be cast into concrete.
3. Division 4 Section "Unit Masonry Assemblies" for installing loose lintels, anchor bolts, and other items indicated to be built into unit masonry.
4. Division 5 Section "Structural Steel."
5. Division 5 Section "Metal Stairs."

6. Division 9 Section "High Performance Coatings" for surface preparation and application of high-performance coating systems on exterior exposed galvanized steel.
7. Division 10 Section "Wire Mesh Partitions."
8. Division 14 Section "Hydraulic Elevators" for elevator pit ladders and support angles for elevator door sills.

1.3 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening 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.

B. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.
3. 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. Samples for Verification: For each type and finish of abrasive/extruded stair nosings.
1.

D. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

E. Welding certificates.

F. Qualification Data: For professional engineer.

G. Recycled material content documentation for meeting Owners "SPiRiT" Sustainable Design Requirements.

1.5 QUALITY ASSURANCE

A. 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. AWS D1.6, "Structural Welding Code--Stainless Steel."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications 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 metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.7 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.

B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

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. 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 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.3 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500, cold-formed steel tubing.

C. Steel Pipe: ASTM A 53/A 53M, 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).
2. Material: Galvanized steel complying with ASTM A 653/A 653M, commercial steel, Type B, structural steel, Grade 33 (Grade 230), with G90 (Z275) coating; 0.064-inch (1.6-mm) nominal thickness.

E. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

2.4 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.5 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

B. Steel 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. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).

D. Anchor Bolts: ASTM F 1554, Grade 36.

1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

E. Eyebolts: ASTM A 489.

F. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

G. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

H. Wood Screws: Flat head, ASME B18.6.1.

I. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

J. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

K. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/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.

L. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material for Anchors in Exterior Locations: Alloy Group 1 (A1) stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 9 painting Sections.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Available Products:

a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
b. Carboline Company; Carbozinc 621.
c. ICI Devoe Coatings; Catha-Coat 313.

d. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
e. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
f. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.
g. Tnemec Company, Inc.; Tneme-Zinc 90-97.

D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. 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.

G. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.7 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. 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. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. 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.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.8 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from 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. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts if units are installed after concrete is placed.

C. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim and interior miscellaneous steel trim, where indicated.

D. Prime interior miscellaneous steel trim, where indicated with zinc-rich primer.

2.10 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches (200 mm), unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.11 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.

C. Prime plates with zinc-rich primer.

2.12 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.13 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe as indicated.

1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate, where indicated.
2. Where bollards are indicated to receive push-button controls for door operators, provide necessary cutouts for push-button controls and hole for wire.

B. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.

2.14 BICYCLE RACKS

A. Fabricate from Schedule 40 steel pipe, fully welded together, to lengths indicated.

B. Fabricate with NPS 3 (DN 80) top rails and end posts, NPS 1-1/2 (DN 40) bottom rails[and intermediate posts not more than 72 inches (1800 mm) o.c.], and NPS 3/4 (DN 20) vertical separators at approximately 8 inches (200 mm) o.c.

C. Make top rails 36 inches (900 mm) above pavement/floor and bottom rails 4 inches (100 mm) above pavement/floor.

D. Fabricate end posts[and intermediate posts] with 1/4-inch- (6.4-mm-) thick steel baseplates for bolting to concrete slab. Drill end post baseplates at all 4 corners[and intermediate-post baseplates at 2 opposite sides] for 1/2-inch (12.7-mm) anchor bolts.

E. Galvanize bicycle racks after fabrication.

F. Prime bicycle racks with zinc-rich primer compatible with field painting requirements.

2.15 ABRASIVE METAL NOSINGS

A. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions.

1. Available Manufacturers:

a. ACL Industries, Inc.
b. American Safety Tread Co., Inc.
c. Amstep Products.
d. Armstrong Products, Inc.
e. Balco Inc.
f. Granite State Casting Co.
g. Wooster Products Inc.
h. Approved Equal.

2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Drill for mechanical anchors and countersink. Locate not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.

D. Apply bituminous paint to concealed bottoms, sides, and edges of cast-metal units set into concrete.

E. Apply clear lacquer to concealed bottoms, sides, and edges of extruded units set into concrete.

2.16 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.

2.17 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123/A 123M, for galvanizing steel and iron products.

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) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: 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: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Coordinate with Division 9 Section "Painting" for priming requirements of field applied finish coatings.

2.18 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.
3. Space siderails 18 inches (457 mm) apart, unless otherwise indicated.
4. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted brackets, made from same metal as ladder.

B. Steel Ladders:

1. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
2. Rungs: 3/4-inch- (19-mm-) diameter steel bars.
3. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
4. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung by a proprietary process.
5. Available Products:

    a. IKG Industries, a Harsco company; Mebac.
    b. W. S. Molnar Company; SlipNOT.
    c. Locally shop fabricated ladder.

6. Galvanize exterior ladders including brackets and fasteners.
7. Prime interior ladders, where indicated, including brackets and fasteners, with zinc-rich primer.

2.19 ABRASIVE METAL NOSINGS

A. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions.

1. Available Manufacturers:

   a. ACL Industries, Inc.
   b. American Safety Tread Co., Inc.
   c. Amstep Products.
   d. Armstrong Products, Inc.
   e. Balco Inc.
   f. Granite State Casting Co.
   g. Wooster Products Inc.

2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Drill for mechanical anchors and countersink. Locate not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.

D. Apply clear lacquer to concealed bottoms, sides, and edges of extruded units set into concrete.

2.20 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend 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.

C. Bright, Directional Satin Finish, where indicated: No. 4.

D. Dull Satin Finish, where indicated: No. 6.

E. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.21 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. 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.

B. 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.

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 no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 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.

B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

C. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING 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, either metallic or nonmetallic, 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.

3.4 INSTALLING METAL BOLLARDS

A. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete, in formed or core-drilled holes not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.5 INSTALLING BICYCLE RACKS

A. Anchor bicycle racks to existing construction with expansion anchors. Provide four 1/2-inch (12.7-mm) bolts at each end post and 2 at each intermediate post.

3.6 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

A. Center nosings on tread widths.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

C. Seal thresholds exposed to exterior with elastomeric sealant complying with Division 07 Section "Joint Sealants" to provide a watertight installation.

3.7 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded 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. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05500

SECTION 05511 - 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. Preassembled steel stairs with concrete-filled treads.
2. Steel tube and pipe railings attached to metal stairs.
3. Steel pipe handrails attached to walls adjacent to metal stairs.

B. Related Sections include the following:

1. Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements" for salvaging waste steel, recycled material content and regionally procured materials requirements.
2. Division 3 Section "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
3. Division 5 Section "Metal Fabrications" for abrasive stair nosings.
4. Division 5 Section "Ornamental Railings" for ornamental metal railings associated with stairs.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch (6.4 mm), whichever is less.

B. Seismic Performance: Provide metal stairs capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures".

C. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied horizontally and concurrently with 100 lbf/ ft. (1.46 kN/m) applied vertically downward.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill of Guards:

a. Concentrated load of 200 lbf (0.89 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Uniform load of 25 lbf/sq. ft. (1.2 kN/sq. m) applied horizontally.
c. Infill load and other loads need not be assumed to act concurrently.

1.4 SUBMITTALS

A. Product Data: For metal stairs and the following:

1. Grout.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Provide templates for anchors and bolts specified for installation under other Sections.
2. 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. Welding certificates.

D. Qualification Data: For professional engineer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for stairs.

1. Test railings according ASTM E 894 and ASTM E 935.

F. Recycled material content documentation for meeting Owners "SPiRiT" Sustainable Design Requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

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. Preassembled Stairs: Commercial class.

C. 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."

1.6 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.

B. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500 (cold formed).

C. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

D. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

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. 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. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

G. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

H. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material for Anchors in Exterior Locations: Alloy Group 1 (A1) stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. 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.

E. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.5 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. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

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. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

A. Stair Framing:

1. Fabricate stringers of steel channels or tubes as indicated on drawings.

    a. Provide closures for exposed ends of channel/tube stringers.

2. Construct platforms of steel (as indicated on drawings) headers and miscellaneous framing members.
3. Weld stringers to headers; weld framing members to stringers and headers.
4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

B. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.0677 inch (1.7 mm).

1. Steel Sheet: Uncoated cold -rolled steel sheet.
2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will 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. Install abrasive metal nosings as per manufacturer's written instructions.

2.7 RAILINGS

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

C. Form changes in direction of railings as follows:
1. By bending or by inserting prefabricated elbow fittings.

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 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 components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

1. Connect posts to stair framing by direct welding, unless otherwise indicated.
2. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

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.

2.8 STAIR RAILINGS

A. Provide "Pipe and Tube Railings" for railings, and as follows:

1. Fabricate newels as shown.
2. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
3. Connect posts to stair framing by direct welding, unless otherwise indicated.

2.9 GUARD RAILINGS

A. Comply with applicable requirements in Division 5 Section "Ornamental Railings" for railings.

2.10 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. Interior Stairs (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

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 of 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.

G. Place and finish concrete fill for treads and platforms to comply with Division 3 Section "Cast-in-Place Concrete."

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete 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 RAILINGS

1. Adjust 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.

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.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.

C. Galvanized Surfaces, where required for exterior applications: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05511

SECTION 05721 - ORNAMENTAL 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 and wood ornamental railings.
2. Related Sections include the following:
3. Division 5 Section "Metal Stairs" for steel tube railings included with metal stairs.
4. Division 6 Section "Miscellaneous Carpentry" for wood blocking for anchoring railings.
5. Division 6 Section "Interior Architectural Woodwork" for wood railing caps.
6. Division 9 Section "Gypsum Board Assemblies" for metal backing for anchoring railings.

1.3 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.4 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.

B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Top Rails of Guards:
   a. Concentrated load of 200 lbf (0.89 kN) applied in any direction.

2. Infill of Guards:

   a. Concentrated load of 200 lbf (0.89 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).

C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening 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.

D. 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. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Welded connections.
4. Wood railing caps.

E. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

F. Welding certificates.

G. Qualification Data: For professional engineer.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according ASTM E 894 and ASTM E 935.

I. Recycled material content documentation for meeting Owners "SPiRiT" Sustainable Design Requirements.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

B. Product Options: Information on Drawings and in Specifications establishes requirements for system's 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 structural analysis, preconstruction testing, field testing, and in-service performance.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings 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. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code—Stainless Steel."

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 as shown on Drawings.
2. 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.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings 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 railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.8 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. 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.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

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. Stainless-Steel and Wood Ornamental Railings:

a. Architectural Metal Works.
b. Blum, Julius & Co., Inc.
c. Blumcraft of Pittsburgh.
d. CraneVeyor Corp.
e. Livers Bronze Co.
f. Newman Brothers, Inc.
g. P & P Artec.
h. Pisor Industries, Inc.
i. Platers Polishing Company; a division of Rippel Architectural Metals.
j. Tri Tech, Inc.
k. Wagner, R & B, Inc.; a division of the Wagner Companies.
l. Wylie Systems.
m. Zephyr Southwest Ornamental, LLC.
n. Approved Equal.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails, unless otherwise indicated.

1. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.

2.3 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304.

B. Pipe: ASTM A 312/A 312M, Grade TP 304.

C. Plate and Sheet: ASTM A 666, Type 304.

2.4 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform finish indicated, free of cross scratches.

1. Run grain of directionally textured finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.5 FASTENERS

A. General: Provide the following:

1. Stainless-Steel Components: Type 304 stainless-steel fasteners.
2. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
3. Galvanized Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating, where indicated.
4. Dissimilar Metals: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work, unless exposed fasteners are the standard fastening method for railings indicated.

1. Provide square or hex socket flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. Anchors: Provide chemical or torque-controlled expansion anchors, fabricated from orrosion-resistant materials 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.

2.6 MISCELLANEOUS MATERIALS

A. Wood Rails: Hardwood rails of species and profile indicated or, if not indicated, as selected by Architect from manufacturer's standard, with manufacturer's standard transparent finish, and secured to recessed metal subrail.

1. Species and Finish: Cherry, natural finish.
2. Profile: Rectangular shape 1-3/4 by 5 inches (45 by 127 mm) with edges eased to 1/4-inch (6-mm) radius.
3. If not provided by railing manufacturer, Wood Rails may be by Division 6 Section "Interior Architectural Millwork", at contractor's option.

B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

C. 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.

D. 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.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the 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. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

F. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

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 flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

H. Form changes in direction as follows:

1. By inserting prefabricated elbow fittings, flush-elbow fittings, or elbow fittings of radius indicated.

I. 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.

J. Close exposed ends of hollow railing members with prefabricated end fittings.

K. 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.

L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

N. For railing posts set in concrete, provide steel sleeves 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, with steel plate forming bottom closure.

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 mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

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 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 plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Corrosion Protection: Coat concealed surfaces of aluminum and copper alloys that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

3.5 ANCHORING RAILING ENDS

A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends, flanges connected to railing ends, or brackets on underside of rails connected to railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.

3.6 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed gypsum board partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Payment for these services will be made by Owner.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Railings will be tested according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and will 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.

3.8 CLEANING

A. Clean wood rails and painted steel by wiping with a damp cloth and then wiping dry.

B. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

3.9 PROTECTION

A. Protect finishes of railings 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 no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05721

SECTION 06105 - MISCELLANEOUS 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 blocking and nailers.
2. Wood grounds.
3. Wood sleepers.
4. Wood shelving.
5. Plywood backing panels.

B. Related Sections include the following:

1. Division 1 Section "Construction Waste Management" for recycling waste wood material.
2. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
3. Division 6 Section "Interior Architectural Woodwork" for interior woodwork not specified in this Section.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NHLA: National Hardwood Lumber Association.
3. NLGA: National Lumber Grades Authority.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments specified to be High-Temperature (HT) type include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.
6. Metal framing anchors.

C. SPiRiT Submittals:

1. Credit 5.C4: Manufacturers' product data for construction adhesive, including printed statement of VOC content.
2. Credit 5.C5: Composite wood manufacturer's product data for each composite wood product used indicating that bonding agent used contains no urea formaldehyde.
3. Credit 4.C7: Certificates of chain-of-custody signed by manufacturers certifying that products specified to be made from certified wood were made from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria." Include evidence that mill is certified for chain-of-custody by an FSC-accredited certification body.

1.5 QUALITY ASSURANCE

A. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria":

1. Dimension lumber framing.
2. Miscellaneous lumber.
3. Interior wood trim.
4. Shelving and clothes rods.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. 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.
4. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron SBX.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

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.

D. Application: Treat unless otherwise indicated. items indicated on Drawings, and the following:

1. Wood cants, nailers, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawl spaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood).

1. Use treatment that does not promote corrosion of metal fasteners.
2. Use Exterior type for exterior locations and where indicated.
3. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
4. Use Interior Type A, unless otherwise indicated.

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

D. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Concealed blocking.
3. Roof construction.
4. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Furring.
4. Grounds.
5. Utility shelving.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.

C. For exposed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
2. Mixed southern pine, No. 2 grade; SPIB.
3. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
4. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods, No. 2 Common grade; NELMA.
5. Northern species, No. 2 Common grade; NLGA.
6. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

E. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

H. For drywall base bailers cast into concrete foundation walls, use pressure treated fire treated solid wood as indicated anddetailed.

2.5 INTERIOR WOOD TRIM

A. General, where indicated: Provide kiln-dried finished (surfaced) material without finger-jointing.

2.6 SHELVING

A. Shelving, where indicated: Made from one of the following materials, 3/4-inch (19-mm) thick. Do not use particleboard or medium-density fiberboard that contains urea formaldehyde.
1. Medium-density fiberboard with solid-wood front edge.
2. Wood boards of same species and grade indicated above for interior lumber trim for opaque finish.

B. Shelf Cleats: 3/4-by-3-1/2-inch (19-by-89-mm) boards with hole and notch to receive clothes rods, of same species and grade indicated above for interior lumber trim for opaque finish.

C. Shelf Brackets: Prime-painted formed steel with provision to support clothes rod where rod is indicated.

2.7 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19.5-mm) nominal thickness.

2.8 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies 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 and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.9 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Do not splice structural members between supports, unless otherwise indicated.

D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- (38-mm actual-) thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

H. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.

2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's Uniform Building Code.
4. Table 2305.2, "Fastening Schedule," in BOCA's BOCA National Building Code.
5. Table 2306.1, "Fastening Schedule," in SBCCI's Standard Building Code.
6. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's International One- and Two-Family Dwelling Code.

I. 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; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD GROUND, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06105

SECTION 06160 - SHEATHING

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. Wall sheathing.
2. Roof sheathing.
3. Building wrap.

B. Related Sections include the following:

1. Division 1 Sections "Construction Waste Management" and "Sustainable Design Requirements" for salvaging wood waste materials, recycled material content, and regionally procured/manufactured materials requirements.
2. Division 5 Section "Cold Formed Metal Framing".
3. Division 6 Section "Miscellaneous Carpentry" for plywood backing panels.
4. Division 7 Section "Metal Roof Panels".
5. Division 7 Section "Metal Wall Panels".

1.3 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
6. For building wrap, include data on air-/moisture-infiltration protection based on testing according to referenced standards.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Building wrap.

C. SPiRiT Submittals:

1. Credit IEQ 5.C4: Manufacturers' product data for construction adhesive, including printed statement of VOC content.
2. Credit IEQ 5.C4: Composite wood manufacturer's product data for each composite wood product used on the interior of building indicating that bonding agent used contains no urea formaldehyde.
3. Credit MR 4.C2 and MR 4.C4: Certificates by manufacturers certifying that products specified to have required recycled wood content and were manufactured regionally.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For assemblies 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."

B. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria":

1. Plywood.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

A. Plywood: DOC PS 1, unless otherwise indicated.

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA C9.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat all exterior roof and wall sheathing plywood, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Comply with performance requirements in AWPA C27.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Use Exterior type for exterior locations and where indicated.
3. Use Interior Type A, High Temperature (HT) for roof sheathing and where indicated.

B. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Identify fire-retardant-treated plywood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

D. Application: Treat all exterior wall and roof sheathing plywood, unless otherwise indicated.

2.4 WALL SHEATHING

A. Plywood Wall Sheathing: Exterior, Exposure 1 sheathing.

1. Span Rating: Not less than 16/0.
2. Nominal Thickness: Not less than 1/2 inch (13 mm).

2.5 ROOF SHEATHING

A. Plywood Roof Sheathing: Exterior, Exposure 1 sheathing.

1. Span Rating: Not less than 24/0.
2. Nominal Thickness: Not less than 1/2 inch (13 mm).

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

2.7 WEATHER-RESISTANT SHEATHING PAPER

A. Building Wrap: ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

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. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
    b. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
    c. Ludlow Coated Products; Air Stop Housewrap.
    d. Pactiv, Inc.; GreenGuard Classic Wrap.
    e. Raven Industries Inc.; Rufco-Wrap.
    f. Reemay, Inc.; Typar HouseWrap.

3. Water-Vapor Permeance: Not less than 535 g through 1 sq. m of surface in 24 hours per ASTM E 96, Desiccant Method (Procedure A).
4. Allowable UV Exposure Time: Not less than three months.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.8 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.025 inch (0.6 mm).

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. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
    b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Plus Self-Adhered Flashing.
    c. MFM Building Products Corp.; Window Wrap.

d. Polyguard Products, Inc.; Polyguard 300.
e. Protecto Wrap Company; BT-20 XL.
f. Approved equal.

B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's "Uniform Building Code."
4. Table 2305.2, "Fastening Schedule," in BOCA's "BOCA National Building Code."
5. Table 2306.1, "Fastening Schedule," in SBCCI's "Standard Building Code."
6. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's "International One- and Two-Family Dwelling Code."

D. 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. Install fasteners without splitting wood.

E. Coordinate wall and roof 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 assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.

1. Comply with "Code Plus" installation provisions in guide referenced in paragraph above.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:
   a. Screw to cold-formed metal framing.
   b. Space panels 1/8 inch (3 mm) apart at edges and ends.
   c. Screw roof sheathing to metal roof deck and steel roof structure.

3.3 WEATHER-RESISTANT SHEATHING-PAPER INSTALLATION

A. General: Cover sheathing with weather-resistant sheathing paper as follows:

1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap, unless otherwise indicated.

B. Building Paper: Apply horizontally with a 2-inch (50-mm) overlap and a 6-inch (150-mm) end lap; fasten to sheathing with galvanized staples or roofing nails.

C. Building Wrap: Comply with manufacturer's written instructions.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

3.4 SHEATHING JOINT-AND-PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to 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. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.
3. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

3.5 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturers written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches (100 mm), except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over weather-resistant building paper at bottom and sides of openings.
4. Lap weather-resistant building paper over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 06160

SECTION 06402 - 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. Plastic-laminate countertops.
2. Plastic-laminate cabinets.
3. Plastic-laminate countertops.
4. Solid-surfacing-material countertops, where indicated.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 15 Section "Plumbing Fixtures" for lavatories and sinks to be installed in countertops.

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 MED-EX Hardboard, plywood, high-pressure decorative laminate, adhesive for bonding plastic laminate, solid-surfacing material, 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.

B. 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 plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.

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 type of material indicated.

1. Plastic laminates.
2. PVC edge material.
3. Thermoset decorative panels.
4. Solid-surfacing materials.

D. Samples for Verification:

1. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
2. Thermoset decorative-panels, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish.
3. Solid-surfacing materials, 6 inches (150 mm) square.
4. Exposed cabinet hardware and accessories, one unit for each type and finish.

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.

F. SPiRiT Submittals:

1. Credit 5.C4: Manufacturers' product data for installation adhesives, including printed statement of VOC content.
2. Credit 5.C5:

a. Composite wood manufacturer's product data for each composite wood product used indicating that the bonding agent contains no urea formaldehyde.
b. Adhesive manufacturer's product data for each adhesive used indicating that the adhesive contains no urea formaldehyde.

3. Credit 4.C4: Product Data indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.

a. Include statement indicating costs for each product having recycled content.

4. Credit 4.C7: Certificates of chain-of-custody signed by manufacturers certifying that products specified to be made from certified wood were made from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria." Include evidence that mill is certified for chain-of-custody by an FSC-accredited certification body.

1.5 QUALITY ASSURANCE

A. 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.

B. 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.

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.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the WIC 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. Medex board ot approved equal.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:

   a. Formica Corporation.
   b. Nevamar
   c. Wilsonart International; Div. of Premark International, Inc.

D. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.

E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ABA Industries.
   b. Avonite, Inc.
   c. E. I. du Pont de Nemours and Company.
   d. Formica Corporation.
   e. LG Chemical, Ltd.
   f. Meganite Inc.; a division of the Pyrochem Group.
   g. Nevamar Company, LLC; Decorative Products Div.
   h. Samsung; Cheil Industries Inc.
   i. Swan Corporation (The).
   j. Transolid, Inc.
   k. Wilsonart International; Div. of Premark International, Inc.

2. Type: Standard type, unless Special Purpose type is indicated.
3. Colors and Patterns: As selected by Architect from manufacturer's full range.

F. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

G. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Contact Adhesive: 250 g/L.

H. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

I. Adhesive for Bonding Plastic Laminate: PVA.

2.2 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. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.

C. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.

D. Catches: Magnetic catches, BHMA A156.9, B03141.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

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, where indicated:

1. Box Drawer Slides:
   a. Light to Medium Duty Drawers, 16" wide or less, all ball bearing, self closing, handed lever disconnect, full extension slides with 100 lb./pr. (45 kg) load rating.
      1) Standard finish: clear zinc.
      2) 50,000 cycles tested from center pull, only.
      3) Basis of Design: Accuride 3832SC, or approved equal.

2. Box Drawer Slides:
   a. Light to Medium Duty Drawers, 24" wide or less, all ball bearing, rail mount, full extension (over travel) slides, hold-in detent, with 100 lb./pr. (45 kg) load rating and progressive movement.
      1) Standard finish: clear zinc.
      2) 75,000 cycles tested from center pull, only.
      3) Basis of Design: Accuride 7432, or approved equal.

3. Box Drawer Slides:
   a. Heavy Duty Drawers, 24" wide or less, all ball bearing, rail mount, full extension +1in. (25mm) over travel slides, hold-in detent, with 150 lb./pr. (68 kg) load rating and progressive movement.
      1) Standard finish: clear zinc.
      2) 75,000 cycles tested from center pull, only.
      3) Basis of Design: Accuride 4034, or approved equal.

4. Heavy Duty File Drawer Slides:
   a. File Drawers 42 in. wide or less, all ball bearing, rail/bracket mount, full extension + 1 inch (25 mm) over travel slides, hold-in detent, with 200 lb./pr. (90 kg) load rating and sequential movement.
      1) Standard finish: clear zinc.
      2) 75,000 cycles tested from center pull, only.
      3) Basis of Design: Accuride 3640, or approved equal.

5. Keyboard Tray Slide:
   a. Key board tray with adjustable tilt plate, all ball bearing, full extension slides with three position detent and an integral keyboard tray including gel palm rest, storage compartments, cable management and mouse pad
      1) Basis of Design: Accuride CBERGO-TRAY 300, or approved equal.

G. Door Locks: BHMA A156.11, E07121.

H. Drawer Locks: BHMA A156.11, E07041.

I. Grommets for Cable Passage through Countertops: 2-inch (51-mm), black, 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 & Company, 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.

2.3 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood 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.

C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Contact Adhesive: 250 g/L.

E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.4 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. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

D. 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).

E. 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. 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.

F. 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.

2.5 PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Premium.

B. High-Pressure Decorative Laminate Grade: HGS.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. Provide Architect's selections from manufacturer's full range of colors and finishes in the following categories:

a. Solid colors.
b. Solid colors with core same color as surface.
c. Wood grains.
d. Patterns.

D. Grain Direction: Parallel to cabinet fronts.

E. Edge Treatment: Same as laminate cladding on horizontal surfaces.

F. Core Material: Exterior-grade plywood or Medex Board.

G. Core Material at Sinks: Exterior-grade plywood or Medex Board.

2.6 PLASTIC-LAMINATE CABINETS

A. Grade: Premium.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade VGS.
4. Edges: Grade HGS.

D. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.

a. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.

2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

G. 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 SHOP FINISHING

A. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative overlay.

2.8 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Premium.

B. Solid-Surfacing-Material Thickness: 3/4 inch (19 mm).

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].

D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with shop-applied edges of materials and configuration indicated.
2. Fabricate tops with [shop-applied backsplashes] [loose backsplashes for field application].

E. Install integral sink bowls in countertops in shop.

F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.9 CLOSET AND UTILITY SHELVING

A. Grade: Premium.

B. Shelf Material: 3/4-inch (19-mm) thermoset decorative panel with PVC or polyester edge banding.

C. Cleats: 3/4-inch (19-mm) thermoset decorative panel.

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. 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).

B. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.

C. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with recommendations of chemical treatment manufacturer, including those for adhesives used to install woodwork.

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 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, No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish, if needed toggle bolts through metal backing or metal framing behind wall finish..

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops 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.
2. 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.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c.
4. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

G. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in shop.

3.3 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 06402

Section 07115 - BITUMINOUS DAMPPROOFING

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 cold-applied, emulsified-asphalt dampproofing applied to the following surfaces:

1. Exterior, below-grade surfaces of exterior perimeter concrete foundation walls and footings.

B. Related Sections include Division 1 Section "Sustainable Design Requirements" and Division 3 Section "Cast-In-Place Concrete" for concrete footings and foundations.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

B. Material Certificates: For each product, signed by manufacturers.

C. SPiRiT Submittals:

1. Credit IEQ 5.C4: Product Data for dampproofing used on the interior of the building indicating VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit asphalt dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has thoroughly cured.

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. Cold-Applied, Emulsified-Asphalt Dampproofing:

a. Euclid Chemical Company (The).
b. Gardner Asphalt Corporation.
c. Henry Company.
d. Karnak Corporation.
e. Koppers Industries, Inc.
f. Malarkey Roofing Company.
g. Meadows, W. R., Inc.
h. Sonneborn, Div. of ChemRex, Inc.
i. Tamms Industries.

2. Protection Course, Asphalt-Board Type:

a. Grace, W. R. & Co.; Construction Products Div.
b. Meadows, W. R., Inc.
c. Sonneborn, Div. of ChemRex, Inc.

2.2 BITUMINOUS DAMPPROOFING

A. Cold-Applied, Emulsified-Asphalt Dampproofing:

1. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.3 MISCELLANEOUS MATERIALS

A. Protection Course, Asphalt-Board Type: Premolded, 1/8-inch-(3-mm-) thick, multi-ply, semirigid board consisting of a mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt, and faced on 1 side with polyethylene film.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.

1. Begin dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.

1. Apply additional coats if recommended by manufacturer or required to achieve coverages indicated.
2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats.

B. Apply dampproofing to footings and foundation walls where opposite side of wall faces building interior whether indicated or not, unless otherwise indicated to receive waterproofing.

1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches(150 mm) over outside face of footing.
2. Extend 12 inches(300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch-(200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat required for embedding fabric is in addition to other coats required.

C. Apply dampproofing to provide continuous plane of protection on exterior face of inner wythe of exterior masonry cavity walls.

1. Lap dampproofing at least 1/4 inch (6 mm) onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
2. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe, and lap dampproofing at least 1/4 inch (6 mm) onto shelf angles supporting veneer.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. On Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m), or one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

B. On Backs of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

C. On Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

3.5 INSTALLATION OF PROTECTION COURSE

A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing material manufacturer's written recommendations for attaching protection course. Support protection course with spot application of trowel-grade mastic where not otherwise indicated.

3.6 CLEANING

A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION 07115

SECTION 07190 - 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 penetrating (exterior) and film-forming (interior) water-repellent coatings for the following vertical and horizontal surfaces:

1. Concrete (unpainted).
2. Concrete unit masonry (Interior and Exterior unpainted and unglazed).

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 3 Section "Cast-in-Place Concrete" for curing compounds, curing and sealing compounds, and penetrating liquid floor treatments.
3. Division 4 Section "Unit Masonry Assemblies" for unit masonry assemblies.
4. Division 7 Section "Joint Sealants."
5. Division 9 Section "Interior Painting" for paints and coatings.
6. Division 9 Section "High Performance Coatings" for Interior CMU in wet locations to receive Epoxy paint.

1.3 PERFORMANCE REQUIREMENTS

A. Performance Testing: Provide water repellents that comply with test-performance requirements indicated, as evidenced by reports of tests performed by manufacturer by a qualified independent testing agency on manufacturer's standard products applied to substrates simulating those on Project using same application methods to be used for Project.

B. Absorption: Minimum 90 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.

1. Concrete Unit Masonry: ASTM C 140.
2. Hardened Concrete: ASTM C 642.

C. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.

D. Permeability: Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, per ASTM D 1653.

E. Water Penetration and Leakage through Masonry: Maximum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.

F. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 154.

G. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.

1. Reduction of Water Absorption: 80 percent.
2. Reduction in Chloride Content: 80 percent.

1.4 SUBMITTALS

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

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's standard colors.

B. Samples: For each type and color of water repellent and substrate indicated, 12 by 12 inches (300 by 300 mm) in size, with specified water-repellent treatment applied to half of each Sample.

C. Manufacturer Certificates: Signed by manufacturers certifying that water repellents comply with requirements.

D. SPiRiT Submittals: For Credit 5.C4, manufacturers' product data for paints, including printed statement of VOC content and chemical components.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 548 for testing indicated.

C. Test Application: Apply a finish sample for each type of water repellent and substrate required. Duplicate finish of approved sample.

1. Locate each test application as directed by Architect.
2. Size: 25 sq. ft. (2.3 sq. m).
3. Final approval by Architect of color and water-repellent application will be from test applications.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:

1. Ambient temperature is above 40 deg F (4.4 deg C).
2. Concrete surfaces and mortar have cured for more than 28 days.
3. Concrete or brick masonry walls are not treated prior to 30 days after building close-in.
4. Rain or snow is not predicted within 24 hours.
5. Application proceeds more than 24 hours after surfaces have been wet.
6. Substrate is not frozen, or surface temperature is above 40 deg F (4.4 deg C).
7. Windy conditions do not exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in Part 1 "Performance Requirements" Article within specified warranty period.

1. Warranty Period: Five 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, 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 PENETRATING WATER REPELLENTS

A. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blends with 3.3 lb/gal. (400 g/L) or less of VOCs.

1. Available Products:

a. Anti-Hydro International, Inc.; Aridox 40.
b. Chemprobe Coating Systems, L. P.; Deck A Pell 15%.
c. Gemite Products, Inc.; Gem Guard SX.
d. Hydrozo, a division of ChemRex; Enviroseal 7.
e. L&M Construction Chemicals, Inc.; Aquapel.
f. Pecora Corporation; 910W.
g. ProSoCo, Inc.; Weatherseal GP.
h. Seal-Krete, Inc.; Silane/Siloxane Water Repellent.
i. Sonneborn Building Products, a division of ChemRex; White Roc 10 WB.
j. Tamms Industries, Inc.; Baracade WB 244.

k. Wacker Chemical Corp.; OH 100.

2.3 FILM-FORMING WATER REPELLENTS

A. Silicone Sealer, Film-Forming Water Repellent: Clear, polymerized, silicone-resin water repellent for dense substrates; with a solvent- or water-based solution containing not less than 3 and up to 5 percent solids by weight; and with 3.3 lb/gal. (400 g/L) or less of VOCs.

1. Available Products:

a. ChemMasters; Aquanil HS Silicone.
b. Euclid Chemical Company (The); Silicone Waterpeller W.
c. Specco Industries, Inc.; S-7 Silicone Water Repellent.
d. Wacker Chemical Corp.; 17711.

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 water-repellent manufacturer's written instructions, to ensure that surface is dry enough.

1. Cast-in-Place Concrete: Remove oil, curing compounds, laitance, and other substances that could prevent adhesion or penetration of water repellents.

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. 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.

C. 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 CLEANING

A. 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 07190

SECTION 07210 - BUILDING INSULATION

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 building insulation.
2. Vapor retarders.
3. Sound attenuation insulation.
4. Insulation under slabs-on-grade.
5. Foundation wall insulation (supporting backfill).

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 3 Section "Cast-In-Place Concrete" for concrete foundation walls and slabs on grade.
3. Division 5 Section "Cold Formed Metal Framing" for installation in metal-framed assemblies of insulation specified by referencing this Section.
4. Division 9 Section "Gypsum Board Assemblies" for installation in metal-framed assemblies of insulation specified by referencing this Section.
5. Division 9 Section "Acoustical Panel Ceilings" for installation above acoustical ceiling systems of sound attenuation blanket insulation specified by this Section.
6. Division 15 Section "Mechanical Insulation."

1.3 DEFINITIONS

A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.4 SUBMITTALS

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

B. Samples for Verification: Full-size units for each type of exposed insulation indicated.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

D. SPiRiT Submittals:

1. Credit MR 4.C4: Product Data indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.

    a. Include statement indicating costs for each product having recycled content.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide insulation and related 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. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by 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.

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. 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.

B. Extruded-Polystyrene Board Insulation:

    a. DiversiFoam Products.
    b. Dow Chemical Company.
    c. Owens Corning.
    d. Tenneco Building Products.

C. Glass-Fiber Insulation:

    a. CertainTeed Corporation.

b. Johns Manville Corporation.
c. Knauf Fiber Glass.
d. Owens Corning.

2.2 INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards.

1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively:

1. Type IV, 1.60 lb/cu. ft. (26 kg/cu. m), unless otherwise indicated.

C. Unfaced Mineral-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

2.3 VAPOR RETARDERS

A. Foil-Polyester-Film Vapor Retarders: 2 layers of 0.5-mil- (0.013-mm-) thick polyester film laminated to an inner layer of 1-mil- (0.025-mm-) thick aluminum foil, with maximum water-vapor transmission rate in flat condition of 0.0 g/h x sq. m and with maximum flame-spread and smoke-developed indexes of 25 and 60, respectively.

1. Product: Subject to compliance with requirements, provide "Zero Perm" by Alumiseal Corporation.

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 with demonstrated capability to bond vapor retarders securely to substrates indicated.

2.4 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.5 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:

1. Available Products:

a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
b. Eckel Industries of Canada; Stic-Klip Type N Fasteners.
c. Gemco; Spindle Type.
d. Approved equal.

2. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
3. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.

B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.

1. Available Products:

a. AGM Industries, Inc.; RC150.
b. AGM Industries, Inc.; SC150.
c. Gemco; Dome-Cap.
d. Gemco; R-150.
e. Gemco; S-150.
f. Approved equal.

2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
a. Ceilings.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

1. Available Products:

a. AGM Industries, Inc.; TACTOO Adhesive.
b. Eckel Industries of Canada; Stic-Klip Type S Adhesive.
c. Gemco; Tuff Bond Hanger Adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated 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. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, 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.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

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. Seal joints between foam-plastic insulation 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. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated.

1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

D. Install mineral-fiber insulation 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 cavity, 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.
4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

E. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.5 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Install 3-inch- (76-mm-) thick, unfaced slag-wool-fiber/rock-wool-fiber blanket insulation over suspended ceilings at partitions in a width that extends insulation 48 inches (1219 mm) on either side of partition.

3.6 INSTALLATION OF VAPOR RETARDERS

A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (400 mm) o.c.

C. Before installing vapor retarder, 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.

D. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

E. 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 retarder.

F. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.7 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

A. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

1. If not indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.

B. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection board. Set in adhesive according to insulation manufacturer's written instructions.

C. Protect top surface of horizontal insulation from damage during concrete work by applying protection board.

3.8 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 07210

SECTION 07411 - METAL ROOF 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, standing-seam metal roof panels.
2. Metal soffit panels.

B. Related Sections include the following:

1. Division 01 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 06 Section "Sheathing" for installing metal roofing panels over plywood sheathing.
3. Division 07 Section "Metal Wall Panels" for installing factory-formed metal soffit panels integrated with metal wall panels, trim and flashing.
4. Division 07 Section "Sheet Metal Flashing and Trim" for installing factory-formed metal soffit panels integrated with sheet metal flashing and trim associated with metal roof and wall panels.
5. Division 07 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.3 DEFINITIONS

A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.

B. Solar Flux: Direct and diffuse radiation from the sun received at ground level over the solar spectrum, expressed in watts per square meter.

C. Solar Reflectance: Fraction of solar flux reflected by a surface, expressed as a percent or within the range of 0.00 and 1.00.

D. Steel Sheet Thickness: Minimum thickness of base metal without metallic coatings or painted finishes.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of roof area when tested according to ASTM E 1680 at the following test-pressure difference:
   1. Test-Pressure Difference: Positive and negative 1.57 lbf/sq. ft. (75 Pa).
   2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (720 Pa) and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
   3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

C. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:

   1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).
   2. Test-Pressure Difference: 20 percent of positive design wind pressure, but not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12.0 lbf/sq. ft. (575 Pa).
   3. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (720 Pa) and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
   4. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

D. Water Absorption: Maximum 1.0 percent absorption rate by volume when tested according to ASTM C 209.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift resistance class indicated.

F. FMG Listing: Provide metal roof panels and component materials that comply with requirements in FMG 4471 as part of a panel roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.

   1. Fire/Windstorm Classification: Class 1A-90.
   2. Hail Resistance: MH.

G. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:

   1. Wind Loads: Determine loads based on the following minimum design wind pressures:

      a. Uniform pressure of 20 lbf/sq. ft., acting inward or outward.
      b. Uniform pressure as indicated on Drawings.

   2. Snow Loads: 30 lbf/sq. ft.

3. Deflection Limits: Engineer metal roof panel assemblies to withstand design loads with vertical deflections no greater than 1/180 of the span.

H. Seismic Performance: Provide metal roof panel assemblies capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures".

I. Thermal Movements: Provide metal roof panel assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, 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.

J. Thermal Performance: Provide insulated metal roof panel assemblies with thermal-resistance value (R-value) indicated when tested according to ASTM C 236 or ASTM C 518.

K. Solar Reflectance: Initial solar reflectance of not less than 0.70 when tested according to ASTM E 903, and maintained, under normal conditions, solar reflectance of not less than 0.50 for 3 years after installation.

L. Minimum Emissivity Rating: Provide roofing materials with 0.9 or greater emissivity when tested according to ASTM E 408.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roof panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, 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. Flashing and trim.
b. Gutters.
c. Downspouts.

2. 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. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:

1. Roof panels and attachments.
2. Roof-mounted items including equipment supports, pipe supports and penetrations, lighting fixtures, snow guards, and items mounted on roof curbs.

D. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Roof and Soffit Panels: 12 inches (300 mm) long by actual panel width. Include fasteners, clips, closures, and other metal roof panel accessories.
2. Trim and Closures: 12 inches (300 mm) long. Include fasteners and other exposed accessories.
3. Vapor Retarders: 6-inch- (150-mm-) square Samples.
4. Accessories: 12-inch- (300-mm-) long Samples for each type of accessory.

F. Qualification Data: For Installer, professional engineer, testing agency.

G. Material Certificates: For vapor retarders, signed by manufacturers.

H. Field quality-control inspection reports.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:

1. Metal Roof and Soffit Panels: Include reports for air infiltration, water penetration, thermal performance, fire-test-response characteristics, solar reflectance, and structural performance.
2. Insulation and Vapor Retarders: Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.

J. Maintenance Data: For metal roof panels to include in maintenance manuals.

K. Warranties: Special warranties specified in this Section.

L. SPIRIT Submittals:

1. Product Data for Credit SS 1.C7: For roof materials, indicating that roof materials comply with ENERGY STAR requirements and have a minimum emissivity of 0.9.
2. Product Data for Credit MR 4.C4: For material with recycled material content.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1. Installer's responsibilities include fabricating and installing metal roof panel assemblies and providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of data for metal roof panels, including 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: Qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal roof panels 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.

E. Fire-Resistance Ratings: Where indicated, provide metal roof panels 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. Combustion Characteristics: ASTM E 136.
2. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
3. Metal roof panels shall be identified with appropriate markings of applicable testing and inspecting agency.

F. Surface-Burning Characteristics: Provide insulated metal roof panels having insulation core material 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 Index: 25 or less, unless otherwise indicated.
2. Smoke-Developed Index: 450 or less, unless otherwise indicated.

G. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Build mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately 48 inches (1200 mm) square by full thickness, including insulation, attachments, and accessories.
2. Approval of mockups is for other material and construction qualities specifically approved by Architect in writing.
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.

H. 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 metal roof panel assemblies including, but not limited to, the following:

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, purlin and rafter Installer, and installers whose work interfaces with or

affects metal roof panels including installers of roof accessories and roof-mounted equipment.

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 methods and procedures related to metal roof panel installation, including manufacturer's written instructions.
4. Examine roof structure and sheathing conditions for compliance with requirements, including flatness and attachment to structural members.
5. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
6. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
7. Review temporary protection requirements for metal roof panel assembly during and after installation.
8. Review roof observation and repair procedures after metal roof panel installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof 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 roof panels without field measurements, or allow for field-trimming of panels. Coordinate roof construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.9 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations, which are specified in Division 7 Section "Roof Accessories."

B. Coordinate metal panel roof assemblies with rain drainage work, flashing, trim, and construction of purlins and rafters, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof 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: Ten years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Weathertight Warranty Period: 10 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. Basis-of-Design Product: The design for each metal roof panel specified is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 PANEL MATERIALS

A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
2. Surface: Smooth, flat finish.
3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings.

a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1) Fluoropolymer Three-Coat System: Manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil (0.038 mm); complying with physical properties and coating performance requirements of AAMA 2605, except as modified below:

a) Humidity Resistance: 2000 hours.
b) Salt-Spray Resistance: 2000 hours.

4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils (0.76 to 1.0 mm) thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
2. Low Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
3. Available Products:

    a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "HR."
    b. Grace, W. R. & Co.; Vycor Ultra.
    c. Henry Company; Perma-Seal PE.
    d. Metal-Fab Manufacturing, LLC; MetShield.
    e. TC MiraDRI; WIP 300HT.

B. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft. (0.24 kg/sq. m), rosin sized.

2.4 MISCELLANEOUS METAL FRAMING

A. General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating.

B. Hat-Shaped, Rigid Furring Channels, where indicated or required: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
2. Depth: 7/8 inch (22 mm).

C. Cold-Rolled Furring Channels, where indicated or required: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (13-mm-) wide flange.

1. Depth: 3/4 inch (19 mm).
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

D. Z-Shaped Furring, where indicated or required: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

E. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.

1. Fasteners for Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.

2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and snapping panels together.

1. Basis-of-Design Product: MBCI LoKSeam or a comparable product of one of the following:
2. Available Manufacturers:

   a. AEP-Span.
   b. Architectural Building Components.
   c. Architectural Roofing and Siding, Inc.
   d. ATAS International, Inc.
   e. Berridge Manufacturing Company.
   f. BHP Steel Building Products USA Inc.
   g. CENTRIA Architectural Systems.
   h. MBCI; Div. of NCI Building Systems.
   i. Metal Sales Manufacturing Corporation.
   j. Perma-Clad Products.

3. Material: Zinc-coated (galvanized) steel sheet, 0.0209 inch (0.55 mm) thick.

   a. Exterior Finish: Fluoropolymer.
   b. Color: As selected by Architect from manufacturer's full range.

2.7 METAL SOFFIT PANELS

A. General: Provide factory-formed metal soffit panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.

B. V-Groove-Profile Metal Soffit Panels: Prefinished panels formed with vertical panel edges and flat pan between panel edges; with V-groove joint between panels. Perforated where indicated.

1. Basis-of-Design Product: MBCI V-Groove Soffit Panel or a comparable product of one of the following:
2. Available Manufacturers:

   a. ATAS International, Inc.
   b. Berridge Manufacturing Company.
   c. Petersen Aluminum Corporation.

3. Material: Same material, finish, and color as metal roof panels.

4. Panel Coverage: 12 inches (305 mm).
5. Panel Height: 0.44 inch (11 mm).

2.8 ACCESSORIES

A. Roof Panel Accessories, as required: Provide components required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
2. Clips: Minimum 0.0625-inch- (1.6-mm-) thick, stainless-steel panel clips designed to withstand negative-load requirements.
3. Cleats: Mechanically seamed cleats formed from minimum 0.0250-inch- (0.64-mm-) thick, stainless-steel or nylon-coated aluminum sheet.
4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Fascia, Flashing and Trim: Formed from 0.0179-inch- (0.45-mm-) thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

C. Gutters, where indicated: Formed from 0.0179-inch- (0.45-mm-) thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, sized according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced 36 inches (900 mm) o.c., fabricated from same metal as gutters. Provide bronze, copper, or aluminum wire ball strainers at outlets. Finish gutters to match metal roof panels and roof fascia and rake trim.

D. Downspouts, where indicated: Formed from 0.0179-inch- (0.45-mm-) thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; in 10-foot- (3-m-) long sections, complete with formed elbows and offsets. Finish downspouts to match metal roof panels.

E. Roof Curbs, where indicated or not provided by another Division: Fabricated from 0.0478-inch- (1.2-mm-) thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; with welded top box and bottom skirt, and integral full-length cricket. Fabricate curb subframing of minimum 0.0598-inch- (1.5-mm-) thick, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads, of size and height indicated. Finish roof curbs to match metal roof panels.

F. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.9 FABRICATION

A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs for full length of panel.

C. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.

D. 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. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal roof panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but not less than thickness of metal being secured.

2.10 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 and painted 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof 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 subpurlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

A. Felt Underlayment, where indicated: Install felt underlayment and building-paper slip sheet on roof sheathing under metal roof panels, unless otherwise recommended by metal roof panel manufacturer. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal roof panels. Apply at locations indicated on Drawings, in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

1. Apply on roof not covered by self-adhering sheet underlayment. Lap edges of self-adhering sheet underlayment not less than 3 inches (75 mm), in shingle fashion to shed water.

B. Self-Adhering High Temperature Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under metal roof panels. Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply at locations indicated on Drawings, in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Roof perimeter for a distance up from eaves of 24 inches (600 mm) beyond interior wall line.
2. Valleys, from lowest point to highest point, for a distance on each side of 18 inches (460 mm). Overlap ends of sheets not less than 6 inches (150 mm).
3. Rake edges for a distance of 18 inches (460 mm).
4. Hips and ridges for a distance on each side of 12 inches (300 mm).
5. Roof to wall intersections for a distance from wall of 18 inches (460 mm).

C. Install flashings to cover underlayment to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

D. Apply slip sheet over underlayment before installing metal roof panels.

3.4 METAL ROOF PANEL INSTALLATION, GENERAL

A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal roof panels by torch is not permitted.
2. Install panels perpendicular to purlins.
3. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels.
4. Provide metal closures at peaks, rake edges, rake walls, and each side of ridge and hip caps.
5. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
6. Locate and space fastenings in uniform vertical and horizontal alignment.
7. Install ridge and hip caps as metal roof panel work proceeds.
8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.

9. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners:

1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and 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 roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

3.5 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

B. Fascia Panels: Align bottom of panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

C. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.

1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Fascia, Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed 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 weather resistant.

1. Install exposed fascia, flashing and trim that is without excessive 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.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet (1.2 m) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Tie downspouts to underground drainage system indicated.

E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.

C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07411

SECTION 07412 - METAL WALL 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, lap-seam metal wall panels.

B. Related Sections include the following:

1. Division 01 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 5 Section "Cold-Formed Metal Framing" for secondary support framing supporting metal wall panels.
3. Division 7 Section "Metal Roof Panels" for factory-formed metal soffit panels.
4. Division 7 Section "Sheet Metal Flashing and Trim" for fasciae, copings, flashings and other sheet metal work not part of metal wall or roof panel assemblies.
5. Division 7 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.3 DEFINITIONS

A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight system.

B. Steel Sheet Thickness: Minimum thickness of base metal without metallic coatings or painted finishes.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide metal wall panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

C. Water Penetration: No water penetration when tested according to ASTM E 331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12 lbf/sq. ft. (575 Pa).

D. Water Penetration: No evidence of water leakage when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12 lbf/sq. ft. (575 Pa).

1. Water Leakage: As defined according to AAMA 501.1.
2. Water Leakage: Uncontrolled water infiltrating the system or appearing on system's normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.

E. Water Absorption: Maximum 1.0 percent absorption rate by volume when tested according to ASTM C 209.

F. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:

a. Uniform pressure as indicated on Drawings.

2. Deflection Limits: Engineer metal wall panel assemblies to withstand test pressures with deflection no greater than 1/240 of the span and no evidence of material failure, structural distress, or permanent deformation exceeding 0.2 percent of the clear span.

a. Test Pressures: 150 percent of inward and outward wind-load design pressures.

G. Seismic Performance: Provide metal wall panel assemblies capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

H. Thermal Movements: Provide metal wall panel assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, 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.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal wall panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal wall 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. Flashing and trim.
b. Downspouts.

2. 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. Coordination Drawings: Exterior elevations drawn to scale and coordinating penetrations and wall-mounted items. Show the following:

1. Wall panels and attachments.
2. Stud framing.
3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.

D. Samples for Initial Selection: For each type of metal wall panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.
2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Wall Panels: 12 inches (300 mm) long by actual panel width. Include fasteners, closures, and other metal wall panel accessories.

a. Include four-way joint for composite panels.

2. Trim and Closures: 12 inches (300 mm) long. Include fasteners and other exposed accessories.
3. Vapor Retarders: 6-inch- (150-mm-) square Samples.
4. Accessories: 12-inch- (300-mm-) long Samples for each type of accessory.
5. Exposed Gaskets: 12 inches (300 mm) long.
6. Exposed Sealants: 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 metal wall panels adjacent to joint sealants.

F. Qualification Data: For Installer.

G. 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.

H. Field quality-control test reports.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:

1. Metal Wall Panels: Include reports for air infiltration, water penetration, thermal performance, fire-test-response characteristics, and structural performance.
2. Insulation and Vapor Retarders: Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.

J. Research/Evaluation Reports: For metal-faced composite wall panels.

K. SPiRiT Submittals:

1. Product Data for Credit MR 4.C4: For material with recycled material content.

L. Maintenance Data: For metal wall panels to include in maintenance manuals.

M. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain each type of metal wall panel through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal wall panels 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.

E. Fire-Resistance Ratings: Where indicated, provide metal wall panels 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. Combustion Characteristics: ASTM E 136.
2. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
3. Metal wall panels shall be identified with appropriate markings of applicable testing and inspecting agency.

F. Surface-Burning Characteristics: Provide insulated metal wall panels having insulation-core 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 Index: 25 or less, unless otherwise indicated.
2. Smoke-Developed Index: 450 or less, unless otherwise indicated.

G. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Build mockup of typical corner wall panel, including soffit, as shown on Drawings; approximately 48 inches (1200 mm) square by full thickness, including insulation, supports, attachments, and accessories.

2. Approval of mockups is for other material and construction qualities specifically approved by Architect in writing.
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.

H. Preliminary Siding Conference: Before starting wall framing 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 wall framing and sheathing construction and metal wall panels including, but not limited to, the following:

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal wall panel Installer, metal wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal wall panels including installers of doors, windows, and louvers.
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 methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal wall panel assembly during and after installation.
8. Review wall panel observation and repair procedures after metal wall panel installation.

I. 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 metal wall panel assemblies including, but not limited to, the following:

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal wall panel Installer, metal wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal wall panels including installers of doors, windows, and louvers.
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 methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
6. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.

7. Review temporary protection requirements for metal wall panel assembly during and after installation.
8. Review wall panel observation and repair procedures after metal wall panel installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.

B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal wall panels from exposure to sunlight and high humidity, except to extent necessary for period of metal wall panel installation.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall 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.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal wall panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Weathertight 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. Basis-of-Design Products: The design for each metal wall panel specified is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable approved equal product by one of the other manufacturers specified.

2.2 PANEL MATERIALS

A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
2. Surface: Smooth, flat finish.
3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings.

1) Fluoropolymer Three-Coat System: Manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil (0.038 mm); complying with physical properties and coating performance requirements of AAMA 2605, except as modified below:

a) Humidity Resistance: 1000 hours.
b) Salt-Spray Resistance: 1000 hours.

4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.3 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL WALL PANELS

A. Refer to Division 7 Section "Building Insulation."

2.4 SUBSTRATE BOARDS

A. See Division 6 Section "Sheathing" for exterior plywood wall sheathing.

2.5 MISCELLANEOUS METAL FRAMING

A. Steel Sheet Components, General: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.

B. Zee Clips: 0.079-inch (2.0-mm) bare steel thickness, cold-formed, galvanized steel sheet.

C. Base or Sill Angles: 0.079-inch (2.0-mm) bare steel thickness, cold-formed, galvanized steel sheet.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
2. Depth: 7/8 inch (22 mm).

E. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (13-mm-) wide flange.

1. Depth: 3/4 inch (19 mm).
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

F. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

G. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.6 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating.

1. Fasteners for Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.
2. Fasteners for Wall Panels: Self-drilling or self-tapping 410 stainless or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
3. Exposed Fasteners for Composite Panels: Stainless steel.
4. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
5. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. General: Provide factory-formed metal wall panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.

B. Flush-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.

1. Basis-of-Design Product: ATAS; Design Wall, or a comparable approved equal product of one of the following:
2. Available Manufacturers:

a. AEP-Span.
b. Architectural Building Components.
c. Architectural Roofing and Siding, Inc.
d. Berridge Manufacturing Company.
e. BHP Steel Building Products USA Inc.
f. CENTRIA Architectural Systems.
g. Fabral, Inc.
h. MBCI; Div. of NCI Building Systems.

i. United Steel Deck, Inc.; Subsidiary of Bouras Industries, Inc.
j. Approved equal.

3. Material: Zinc-coated (galvanized) steel sheet, 24 gauge thick.

a. Exterior Finish: Fluoropolymer.
b. Color: As selected by Architect from manufacturer's full range.

4. Panel Coverage: 12 inches (305 mm).
5. Panel Height: 1.75 inches (44 mm).

2.8 FABRICATION

A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
2. Fabricate wall panels with panel stiffeners as required to maintain fabrication tolerances and to withstand design loads.

B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Where indicated, fabricate metal wall panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.

E. 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. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.9 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 and painted 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.

1. Examine primary and secondary wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall 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. Substrate Board: Install substrate board over wall sheathing on entire wall surface. Attach with substrate-board fasteners.

1. Install substrate board with long joints in continuous straight lines, perpendicular to direction of metal wall panel seams with end joints staggered between rows. Tightly butt substrate boards together.
2. Comply with UL requirements for fire-rated construction.

C. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

D. Install fasciae and copings to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

E. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal wall panel manufacturer's written recommendations.

3.3 METAL WALL PANEL INSTALLATION, GENERAL

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal wall panels by torch is not permitted.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
4. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
5. Install screw fasteners in predrilled holes.
6. Locate and space fastenings in uniform vertical and horizontal alignment.
7. Install flashing and trim as metal wall panel work proceeds.
8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners:

1. Steel Wall Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and 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 wall panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

3.4 FIELD-ASSEMBLED METAL WALL PANEL INSTALLATION

A. Lap-Seam Metal Wall Panels: Fasten metal wall panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal wall panels.
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 wall panels and between panels and protruding equipment, vents, and accessories.
5. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps, and on side laps of nesting-type panels; on side laps of corrugated nesting-type, ribbed, or fluted panels; and elsewhere as needed to make panels weatherproof to driving rains.
6. At panel splices, nest panels with minimum 6-inch (150-mm) end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

B. Zee Clips: Provide Zee clips of size indicated or, if not indicated, as required to act as standoff from subgirts for thickness of insulation indicated. Attach to subgirts with fasteners.

3.5 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed 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 weather resistant.

1. Install exposed flashing and trim that is without excessive 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.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal wall 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 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Water Penetration: Test areas of installed system indicated on Drawings for compliance with system performance requirements according to ASTM E 1105 at minimum differential pressure of 20 percent of inward-acting, wind-load design pressure as defined by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," but not less than 6.24 lbf/sq. ft. (300 Pa).

C. Water-Spray Test: After completing the installation of 75-foot- (23-m-) by-2-story minimum area of metal wall panel assembly, test assembly for water penetration according to AAMA 501.2 in a 2-bay area directed by Architect.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed metal wall panel installation, including accessories. Report results in writing.

E. Remove and replace applications of metal wall panels where inspections indicate that they do not comply with specified requirements.

F. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07412

SECTION 07540 - THERMOPLASTIC 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. Fully adhered Thermoplastic Olefin (TPO) Energy Star membrane roofing system.
2. Vapor retarder.
3. Roof insulation.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 5 Section "Steel Deck" for metal roof deck
3. Division 6 Section "Miscellaneous Carpentry" for wood nailers, and blocking.
4. Division 7 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
5. Division 7 Section "Joint Sealants."
6. Division 15 installed "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; 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. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7. Match the existing roofing system installed on the building and able to be warranted by the same manufacturer. The existing warranty is to remain in place.

1. Wind Zone 3: For velocity pressures of 46 to 104 lbf/sq. ft. (2.20 to 4.98 kPa): 208-lbf/sq. ft. (9.96-kPa) perimeter uplift force, 312-lbf/sq. ft. (14.94-kPa) corner uplift force, and 104-lbf/sq. ft. (4.98-kPa) outward force.

D. 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.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail Resistance: MH.

E. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist the factored design uplift pressures calculated according to SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems."

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.

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-by-12-inch (300-by-300-mm) square of walkway pads or rolls.
4. 12-inch (300-mm) length of metal termination bars.

D. 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.

E. Certified Letter: Provide a letter from the manufacturer stating the materials furnished contain no asbestos.

F. Qualification Data: For Installer and manufacturer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.

H. Research/Evaluation Reports: For components of membrane roofing system.

I. Maintenance Data: For roofing system to include in maintenance manuals.

J. Warranties: Special warranties specified in this Section.

K. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

L. SPiRiT Submittals:

1. Credit 1.C7: Manufacturers' product data for Energy Star Roof compliant, high reflectance and low emissivity roofing for a minimum of 75% of the roofing area.

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.

B. Manufacturer Qualifications: A qualified manufacturer that has UL listing and FMG approval for membrane roofing system identical to that used for this Project.

C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

D. Source Limitations: Obtain components for membrane roofing system from or approved by roofing membrane manufacturer.

E. 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.

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 standard form, without monetary limitation, in which 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. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover boards, substrate board, vapor retarder, walkway products and other components of membrane roofing system.
2. Warranty Period: 15 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, 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, roof pavers, 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. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE

A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: Uniform, flexible sheet formed from a thermoplastic polyolefin, internally fabric or scrim reinforced membrane, and as follows:

1. Available Manufacturers:

a. Carlisle SynTec Incorporated.
b. Firestone Building Products Company.
c. GAF Materials Corporation.
d. GenFlex Roofing Systems.
e. Johns Manville International, Inc.
f. Sarnafil Inc.
g. Stevens Roofing Systems; Div. of JPS Elastomerics.
h. Approved equal, as required to match existing.

2. Thickness: 60 mils (1.5 mm), nominal.
3. Exposed Face Color: White, Energy Star.
4. Physical Properties:

a. Breaking Strength: 225 lbf (1 kN); ASTM D 751, grab method.
b. Elongation at Break: 15 percent; ASTM D 751.
c. Tearing Strength: 55 lbf (245 N) minimum; ASTM D 751, Procedure B.
d. Brittleness Point: Minus 22 deg F (30 deg C).
e. Ozone Resistance: No cracks after sample, wrapped around a 3-inch- (75-mm-) diameter mandrel, is exposed for 166 hours to a temperature of 104 deg F (40 deg C) and an ozone level of 100 pphm (100 mPa); ASTM D 1149.
f. Resistance to Heat Aging: 90 percent minimum retention of breaking strength, elongation at break, and tearing strength after 166 hours at 240 deg F (116 deg C); ASTM D 573.
g. Water Absorption: Less than 4 percent mass change after 166 hours' immersion at 158 deg F (70 deg C); ASTM D 471.

h. Linear Dimension Change: Plus or minus 2 percent; ASTM D 1204.

2.3 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 unreinforced thermoplastic polyolefin sheet flashing, 60mils (1.5 mm) thick, minimum, of same color as sheet membrane.

C. Bonding Adhesive: Manufacturer's standard solvent-based bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings.

D. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

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.

2.4 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 728, perlite board, 3/4 inch (19 mm) thick, seal coated, to matchexisting.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening substrate panel to roof deck.

2.5 VAPOR RETARDER

A. Polyethylene Vapor Retarder: ASTM D 4397, 6 mils (0.15 mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
2. Adhesive: Manufacturer's standard lap adhesive, FMG approved for vapor-retarder application.

2.6 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. Minimum Aged R-Value of R-30.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.

1. Available Manufacturers:

a. AlliedSignal Inc.; Commercial Roofing Systems.
b. Apache Products Company.
c. Atlas Roofing Corporation.
d. Carlisle SynTec Incorporated.
e. Celotex Corporation.
f. Firestone Building Products Company.
g. GAF Materials Corporation.
h. GenFlex Roofing Systems.
i. Hunter Panels, LLC.
j. Johns Manville International, Inc.
k. Koppers Industries.
l. RMAX.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48), unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.7 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. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied bonding adhesive formulated to adhere roof insulation to substrate.

D. Cover Board: ASTM C 208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

E. 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.

F. Metal Securement System: Perimeter securement flashing and strapping fabricated from stainless steel, a minimum of 0.031 inch (0.8 mm) thick. Provide fasteners as recommended by mortar-faced insulation manufacturer.

2.8 ASPHALT MATERIALS

A. Roofing Asphalt: ASTM D 6152, SEBS modified.

B. Asphalt Primer: ASTM D 41.

2.9 WALKWAYS

A. Flexible Walkways, where indicated: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

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 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 minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that roofing substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
6. 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. Install acoustical roof deck rib insulation strips, specified in Division 5 Section "Steel Deck," according to acoustical roof deck manufacturer's written instructions.

3.3 SUBSTRATE BOARD INSTALLATION

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 and adhere substrate board to roof deck according to recommendations in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
2. Fasten substrate board to plywood roof deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturer's written instructions.

3.4 VAPOR-RETARDER INSTALLATION

A. Loosely lay polyethylene-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively.

1. Seal side and end laps with tape.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

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 one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches (50 mm) or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. 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.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Prime surface of roof deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
2. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

3. Set each layer of insulation in a cold fluid-applied adhesive.

H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Stagger joints from joints in insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.

1. Fasten according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
2. Fasten to resist uplift pressure at corners, perimeter, and field of roof.

3.6 ADHERED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.

1. Install sheet according to ASTM D 5036.

B. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply solvent-based bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.

E. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer and install fabric-backed roofing membrane. Do not apply roofing asphalt to splice area of roofing membrane.

F. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

H. 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.

I. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

J. Install roofing membrane and auxiliary materials to tie in to existing roofing.

3.7 BASE FLASHING INSTALLATION

A. Install minimum 24 gauge sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply solvent-based 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.

3.8 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.9 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.

3.10 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.

3.11 ROOFING INSTALLER'S WARRANTY (SAMPLE)

A. WHEREAS <**Insert name**> of <**Insert address**>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner.**>
2. Address: <**Insert address.**>
3. Building Name/Type: <**Insert information.**>
4. Address: <**Insert address.**>
5. Area of Work: <**Insert information.**>
6. Acceptance Date: <**Insert date.**>
7. Warranty Period: <**Insert time.**>
8. Expiration Date: <**Insert date.**>

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

   a. lightning;
   b. peak gust wind speed exceeding 90 mph (m/sec);
   c. fire;
   d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. vapor condensation on bottom of roofing; and
   g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall

become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <**Insert day**> day of <**Insert month**>, <**Insert year**>.

1. Authorized Signature: <**Insert signature.**>
2. Name: <**Insert name.**>
3. Title: <**Insert title.**>

END OF SECTION 07540

SECTION 07620 - 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 the following sheet metal flashing and trim:

1. Manufactured reglets.
2. Formed low-slope roof flashing, fascia, and trim.
3. Formed wall flashing and trim.
4. Formed equipment support flashing, where required.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 4 Section "Unit Masonry Assemblies" for installing flashing, reglets, copings and other sheet metal flashing and trim.
3. Division 6 Section "Miscellaneous Carpentry" for wood nailers, curbs, and blocking.
4. Division 7 Section "EPDM Membrane Roofing" for installing sheet metal flashing and trim integral with roofing membrane.
5. Division 7 Section "Metal Wall Panels" for installation of sheet metal flashing and trim integral with metal wall panels.
6. Division 7 Section "Metal Roof Panels" for installation of sheet metal fascia, flashing and trim integral with metal roofing.
7. Division 7 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

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, rattling, leaking, and fastener disengagement.

B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:

1. Wind Zone 3: For velocity pressures of 46 to 104 lbf/sq. ft. (2.20 to 4.98 kPa): 208-lbf/sq. ft. (9.96-kPa) perimeter uplift force, 312-lbf/sq. ft. (14.94-kPa) corner uplift force, and 104-lbf/sq. ft. (4.98-kPa) outward force.

C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. 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.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
4. Details of expansion-joint covers, including showing direction of expansion and contraction.

C. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches (300 mm) long. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim: 12 inches (300 mm) long. Include fasteners and other exposed accessories.
3. Accessories: Full-size Sample.

E. SPiRiT Submittals:

1. Product Data for Credit MR 4.C4: For material with recycled material content.

1.5 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof coping, approximately 48 inches (1200 mm) long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approval of mockups is for other material and construction qualities specifically approved by Architect in writing.
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.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

A. Coordinate installation of sheet metal fascia, flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

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. 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 SHEET METALS

A. Aluminum Sheet, where indicated: ASTM B 209 (ASTM B 209M), Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:

1. Siliconized-Polyester Coating: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

   a. Color: As selected by Architect from manufacturer's full range.

2. High-Performance Organic Finish: 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.

   a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-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.

      1) Color: As selected by Architect from manufacturer's full range.

B. Prepainted, Metallic-Coated Steel Sheet, where indicated: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
2. Exposed Finishes: Apply the following coil coating:

   a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

      1) Fluoropolymer 2-Coat System: Manufacturer's standard 2-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 physical properties and coating performance requirements of AAMA 2604, except as modified below:

         a) Humidity Resistance: 1000 hours.
         b) Salt-Spray Resistance: 1000 hours.

2.3 UNDERLAYMENT MATERIALS

A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

B. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory- mitered and -welded corners and junctions.

1. Available Manufacturers:

a. Cheney Flashing Company, Inc.
b. Fry Reglet Corporation.
c. Heckmann Building Products Inc.

d. Hickman, W. P. Company.
e. Keystone Flashing Company, Inc.
f. Sandell Manufacturing Company, Inc.

2. Material: Prefinished Aluminum, where exposed, 0.024 inch (0.6 mm) thick, Galvanized steel, where not exposed, 0.0217 inch (0.55 mm) thick].
3. 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.
4. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
6. Flexible Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
7. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal fascia, flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal fascia, flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal fascia, flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with elastomeric butyl sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing and Fascia Caps, where indicated: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Furnish with 6-inch- (150-mm-) wide joint cover plates.

1. Joint Style: Lap, 4 inches (100 mm) wide.
2. Fabricate with scuppers spaced as indicated, of dimensions required with 4-inch- (100-mm-) wide flanges and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
3. Fabricate scuppers from the following material:
   a. Aluminum: 0.050 inch (1.2 mm) thick.
   b. Prepainted, Metallic-Coated Steel: 0.0276 inch (0.7 mm) thick.

B. Copings and Fascia: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.

1. Joint Style Butt, with 12-inch- (300-mm-) wide concealed backup plate and 6-inch- (150-mm-) wide exposed cover plates.
2. Fabricate copings from the following material:

   a. Prepainted, Metallic-Coated Steel: 0.0396 inch (1.0 mm) thick.

C. Base Flashing: Fabricate from one of the following material as required by roofing membrane manufacturer:

1. Galvanized Steel: 0.0276 inch (0.7 mm) thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch (0.7 mm) thick.
3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0276 inch (0.7 mm) thick.

D. Counterflashing: Fabricate from one of the following material as required by roofing membrane manufacturer:

1. Galvanized Steel: 0.0217 inch (0.55 mm) thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.0217 inch (0.55 mm) thick.
3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0217 inch (0.55 mm) thick.

E. Flashing Receivers: Fabricate from one of the following material:

1. Galvanized Steel: 0.0217 inch (0.55 mm) thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.0217 inch (0.55 mm) thick.
3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0217 inch (0.55 mm) thick.

F. Roof-Penetration Flashing: Fabricate from one of the following material, as required by roofing manufacturer:

1. Lead-Coated Copper: 17.2 oz./sq. ft. (0.60 mm thick).
2. Galvanized Steel: 0.0276 inch (0.7 mm) thick.
3. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch (0.7 mm) thick.

4. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0276 inch (0.7 mm) thick.
5. Zinc: 0.031 inch (0.80 mm) thick.

G. Splash Pans, where indicated: Fabricate from one of the following material:

1. Aluminum: 0.040 inch (1.0 mm) thick.
2. Stainless Steel: 0.0187 inch (0.5 mm) thick.
3. Zinc-Tin Alloy-Coated Stainless Steel: 0.018 inch (0.5 mm) thick.

H. Roof-Drain Flashing: Fabricate from one of the following material:

1. Lead: 4.0 lb/sq. ft. (1.6 mm thick), hard tempered.
2. Copper: 13.2 oz./sq. ft. (0.45 mm thick).
3. Lead-Coated Copper: [12 oz./sq. ft. (0.4 mm thick).
4. Zinc-Tin Alloy-Coated Stainless Steel: 0.015 inch (0.4 mm) thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing, not provided by Division 15: Fabricate from one of the following material:

1. Galvanized Steel: 0.0276 inch (0.7 mm) thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch (0.7 mm) thick.
3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0276 inch (0.7 mm) thick.

2.9 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Coat side of uncoated aluminum, stainless-steel and lead sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric butyl sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with elastomeric butyl sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.
2. Aluminum: Use aluminum or stainless-steel fasteners.
3. Copper Use copper or stainless-steel fasteners.
4. Stainless Steel: Use stainless-steel fasteners.

H. Seal joints with elastomeric butyl sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

I. Soldered Joints, where required: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except where pretinned surface would show in finished Work.

1. Do not solder prepainted, metallic-coated steel and aluminum sheet.
2. Pretinning is not required for lead-coated copper, zinc-tin alloy-coated stainless steel and lead.
3. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
4. Copper Soldering: Tin uncoated copper surfaces at edges of sheets using solder recommended for copper work.
5. Where surfaces to be soldered are lead coated, do not tin edges, but wire brush lead coating before soldering.
6. Lead-Coated Copper Soldering: Wire brush edges of sheets before soldering.
7. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

J. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches (100 mm) in direction of water flow.

C. Splash Pans: Install where downspouts discharge on low-sloped roofs. Set in elastomeric sealant compatible with roofing membrane.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.

1. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 24-inch (600-mm) centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 24-inch (600-mm) centers.
2. Anchor interior leg of coping with screw fasteners and washers at 24-inch (600-mm) centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for butyl sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant.

1. Secure in a waterproof manner by means of snap-in installation and sealant or interlocking folded seam or blind rivets and sealant or anchor and washer at 36-inch (900-mm) centers.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
2. Seal with butyl sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Reglets: Installation of reglets is specified in Division 4 Section "Unit Masonry Assemblies."

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with butyl sealant to equipment support member.

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07620

SECTION 07920 - 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 joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:

    a. Construction joints in cast-in-place concrete (ES-3; JS-1).
    b. Control and expansion joints in unit masonry (ES-3; JS-3).
    c. Joints between different materials listed above (ES-1; JS-5).
    d. Perimeter joints between materials listed above and frames of doors, windows, and louvers (ES-1; JS-6).

2. Exterior joints in the following horizontal traffic surfaces:

    a. Isolation and contraction joints in cast-in-place concrete slabs (ES-4; JS-2).
    b. Joints between different materials listed above (ES-8; JS-4).

3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

    a. Perimeter joints of exterior openings where indicated (ES-5; JS-7).
    b. Tile control and expansion joints (ES-9; JS-8).
    c. Vertical joints on exposed surfaces of interior unit masonry, concrete, walls and partitions (ES-6; JS-10).
    d. Perimeter joints between interior wall surfaces and frames of interior doors and windows (ES-5; JS-11).
    e. Joints between plumbing fixtures and adjoining walls, floors, and counters (ES-2; JS-9).

4. Interior joints in the following horizontal traffic surfaces:

    a. Isolation joints in cast-in-place concrete slabs (ES-7; JS-12).
    b. Control and expansion joints in tile flooring (ES-9; JS-8).

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 2 Section "Cast-In-Place Concrete Site Elements" for sealing joints in pavements, walkways, and curbing.
3. Division 4 Section "Unit Masonry Assemblies" for masonry control and expansion joint fillers and gaskets.

4. Division 8 Section "Glazing" for glazing sealants.
5. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
6. Division 9 Section "Ceramic Tile" for sealing tile joints.
7. Division 9 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants for exterior applications 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. Provide joint sealants for exterior and interior traffic surfaces formulated to withstand pedestrian and light vehicular traffic.

D. Meet all Owner Design Standards requirements for sealants as follows:

1. Precast Concrete, metal window walls and metal windows: Silicone Rubber equal to Dow Corning #780, or Polysulfide equal to Thiokol Base, Federal Specification TT-S-00227, or "Hornflex".

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. 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.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with 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.

D. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

E. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

F. Qualification Data: For Installer.

G. 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.

H. Installer's Joint Sealant Schedule: verifying type of sealant to be used for each application, including substrate joint preparation requirements and joint sealant backing requirements.

I. Warranties: Special warranties specified in this Section.

J. Rating System Documentation:
1. Provide a manufacturer's cut sheet for every sealant used within the building (not including the exterior surface of the building0, with V.O.C. levels highlighted.

K. SPiRiT Submittals:

1. Credit 5.C4: Manufacturers' product data for interior sealants, including printed statement of VOC content.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

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 preceding the commencement of the Work.

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. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:

a. Each type of elastomeric sealant and joint substrate indicated.
b. Each type of nonelastomeric sealant and joint substrate indicated.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.

1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

E. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:

1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

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 or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees 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.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees 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: 5 years from date of Substantial Completion.

C. 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 MANUFACTURERS

A. 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, 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.

C. ENVIRONMENTAL QUALITY ASSURANCE

1. Do not use products containing methylene chloride or chlorinated hydrocarbons.
2. Avoid using products containing bactericides and fungicides that are classified as phenol mercury acetates, phenol phenates, or phenol formaldehyde.
3. Avoid products containing aromatic and aliphatic solvents.
4. Avoid products containing styrene butadiene.

D. INDOOR AIR QUALITY

1. The following sealants should be avoided for indoor use:
   a. Butyl rubber (aliphatic hydrocarbons).
   b. Solvent based acrylic (xylene).
   c. Neoprene (xylene).
   d. Styrene butadiene rubber (various VOCs: hexane, toluene, and xylene).
   e. Nitrile (various VOCs: hexane, toluene, and xylene).

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified 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.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

D. Single-Component Neutral- and Basic-Curing Silicone Sealant (ES-1):

1. Available Products:

   a. Dow Corning Corporation; 790.
   b. GE Silicones; SilPruf LM SCS2700.
   c. Tremco; Spectrem 1 (Basic).
   d. GE Silicones; SilPruf SCS2000.
   e. Pecora Corporation; 864.
   f. Pecora Corporation; 890.
   g. Polymeric Systems Inc.; PSI-641.
   h. Sonneborn, Division of ChemRex Inc.; Omniseal.
   i. Tremco; Spectrem 3.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Low VOCs content, maximum 31 grams/liter.
5. Use Related to Exposure: NT (nontraffic).
6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

   a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick, granite, ceramic tile, and wood.

7. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

E. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant (ES-2):

1. Available Products:

   a. Pecora Corporation; 898.
   b. Tremco; Tremsil 600 White.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Low VOCs content, maximum 31 grams/liter.
5. Use Related to Exposure: NT (nontraffic).
6. Uses Related to Joint Substrates: as applicable to joint substrates indicated, O.

   a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and ceramic tile, plastic laminate.

F. Multicomponent Nonsag Urethane Sealant (ES-3):

1. Available Products:

   a. Pecora Corporation; Dynatrol II.
   b. Tremco; Dymeric 511.
   c. Tremco; Vulkem 922.

2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 25.
4. Low VOCs content.
5. Uses Related to Exposure: NT (nontraffic).
6. Uses Related to Joint Substrates: M.

G. Multicomponent Nonsag Urethane Sealant (ES-4):

1. Available Products:
   a. Sika Corporation, Inc.; Sikaflex - 2c NS TG.
   b. Sonneborn, Division of ChemRex Inc.; NP 2.

2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 25.
4. Low VOCs content.
5. Uses Related to Exposure: T (traffic) and NT (nontraffic).
6. Uses Related to Joint Substrates: M.

H. Multicomponent Nonsag Urethane Sealant (ES-5):

1. Available Products:

   a. Bostik Findley; Chem-Calk 500.
   b. Pacific Polymers, Inc.; Elasto-Thane 227 R Type II (Gun Grade).
   c. Polymeric Systems Inc.; PSI-270.
   d. Tremco; Dymeric.

2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 25.
4. Additional Movement Capability: 40 percent movement in extension and 25 percent in compression for a total of 65 percent movement.
5. Low VOCs content.
6. Use Related to Exposure: NT (nontraffic).
7. Uses Related to Joint Substrates: O.

   a. Use O Joint Substrates: Galvanized steel, brick, granite, ceramic tile, wood.

I. Multicomponent Nonsag Urethane Sealant (ES-6):

1. Available Products:

   a. Pacific Polymers, Inc.; Elasto-Thane 227 High Shore Type II (Gun Grade).
   b. Pacific Polymers, Inc.; Elasto-Thane 227 Type II (Gun Grade).
   c. Pecora Corporation; Dynatred.
   d. Polymeric Systems Inc.; PSI-270.

2. Class: 25.
3. Low VOCs content.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M.

J. Multicomponent Pourable Urethane Sealant (ES-7):

1. Available Products:

a. Pecora Corporation; Dynatrol II-SG.
b. Sika Corporation, Inc.; Sikaflex - 2c SL.
c. Sonneborn, Division of ChemRex Inc.; SL 2.

2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 25.
4. Low VOCs content.
5. Uses Related to Exposure: T (traffic) and NT (nontraffic).
6. Uses Related to Joint Substrates: M.

K. Single-Component Nonsag Urethane Sealant (ES-8):

1. Available Products:

a. Sika Corporation, Inc.; Sikaflex - 1a.
b. Sika Corporation, Inc.; Sikaflex - 15LM.
c. Sonneborn, Division of ChemRex Inc.; Ultra.
d. Sonneborn, Division of ChemRex Inc.; NP 1.
e. Tremco; Vulkem 116.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25 and 100/50.
4. Low VOCs content.
5. Uses Related to Exposure: T (traffic) and NT (nontraffic).
6. Uses Related to Joint Substrates: M and, as applicable to joint substrates indicated, O.

a. Use O Joint Substrates: Brick.

L. Single-Component Nonsag Urethane Sealant (ES-9):

1. Available Products:

a. Mameco; Vulkem 116.
b. Sonneborn; NP1.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Low VOCs content.
5. Use Related to Exposure: T (traffic).
6. Uses Related to Joint Substrates: O.

a. Use O Joint Substrates: Ceramic tile.

2.4 LATEX JOINT SEALANTS

A. Latex Sealant (LS-1): Comply with ASTM C 834, Type P, Grade NF, VOC content: 42/grams/liter.

B. Available Products:

1. Bostik Findley; Chem-Calk 600.
2. Pecora Corporation; AC-20+.
3. Schnee-Morehead, Inc.; SM 8200.
4. Sonneborn, Division of ChemRex Inc.; Sonolac.

5. Tremco; Tremflex 834.

2.5 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints (AS-1): 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. Available Products:

a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2.6 PREFORMED TAPE SEALANTS

A. Expanded Cellular Tape Sealant: Closed-cell, PVC foam tape sealant; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
1. Type 2, for applications in which tape is used in combination with a full bead of liquid sealant.

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, Type C (closed-cell material with a surface skin); Type O (open-cell material); Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. 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 to 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 after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates 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. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.
    e. Plastic laminate.>

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 in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in 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 backs of joints.

F. 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 in 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 sealant from surfaces adjacent to joints.
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.
4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.

5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

H. Installation of Preformed Tapes: Install according to manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:

    a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each type of elastomeric sealant and joint substrate.
    b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, Method B, Exposed Surface Finish Hand Pull Tab, Method C, Field-Applied Sealant Joint Hand Pull Flap, or, as appropriate for type of joint-sealant application indicated.

    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; do this by extending cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.
4. Inspect tested joints and report on the following:

    a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
    b. Whether sealants filled joint cavities and are free of voids.
    c. Whether sealant dimensions and configurations comply with specified requirements.

5. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
6. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant 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.

3.6 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 original work.

3.7 WASTE MANAGEMENT

A. Separate waste in accordance with the Waste Management System.

B. Close and seal tightly all partly used sealant containers and store in well-ventilated, fire-safe area at moderate temperature.

C. Place used sealant tubes and containers in areas designated for hazardous materials.

3.8 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application JS-1: Exterior vertical, nontraffic, construction joints in cast-in-place concrete.

1. Joint Sealant: (ES-3).
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

B. Joint-Sealant Application (JS-2): Exterior horizontal traffic, isolation and contraction joints in cast-in-place concrete slabs.

1. Joint Sealant: (ES-4).
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

C. Joint-Sealant Application (JS-3): Exterior vertical control and expansion joints in unit masonry.

1. Joint Sealant: (ES-3).
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

D. Joint-Sealant Application (JS-5): Exterior vertical joints between different materials listed above.

1. Joint Sealant: (ES-5).
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

E. Joint-Sealant Application (JS-6): Exterior perimeter joints between masonry, and frames of doors, windows, and louvers.

1. Joint Sealant: (ES-1).
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

F. Joint-Sealant Application (JS-7): Interior perimeter joints of exterior openings.

1. Joint Sealant: (ES-5).
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

G. Joint-Sealant Application (JS-8): Interior ceramic tile expansion, control, contraction, and isolation joints in horizontal traffic surfaces.

1. Joint Sealant: (ES-10).
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

H. Joint-Sealant Application (JS-9): Interior joints between plumbing fixtures and adjoining walls, floors, and counters.

1. Joint Sealant: Single-component mildew-resistant neutral-curing silicone sealant (ES-2).
2. Joint-Sealant Color: White or clear.

I. Joint-Sealant Application (JS –10): Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.

1. Joint Sealant: (ES-6).
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

J. Joint-Sealant Application (JS-11): Perimeter joints between interior wall surfaces and frames of interior doors and windows.

1. Joint Sealant: (ES-5).
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

K. Joint-Sealant Application (JS-12): Isolation and expansion joints in interior concrete floor slabs.

1. Joint Sealant: (ES-7).
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07920

SECTION 08111 - STANDARD STEEL DOORS AND FRAMES AND VAULT DOOR

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. Standard hollow-metal steel doors.
2. Standard hollow-metal steel frames.
3. Class 5 Vault Door.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for recycled material content requirements.
2. Division 4 Section "Unit Masonry Assemblies" for building anchors into and grouting standard steel frames in masonry construction.
3. Division 8 Section "Glazing" for glazed lites in standard steel doors.
4. Division 8 Section "Door Hardware" for door hardware for standard steel doors.
5. Division 9 Section "Gypsum Board Assemblies" for metal framed walls and partitions.
6. Division 9 Section "Painting" for field painting standard steel doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of steel door and frame specified.

B. Shop Drawings: In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details.
3. Frame details for each frame type, including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Details of glazing frames and stops showing glazing.

8. Details of conduit and preparations for electrified door hardware and controls.

C. Vault Door Certification: For Class 5-A Armory Vault door assemblies required to be GSA rated and exceeding limitations of labeled assemblies; include statement that doors comply with requirements of GSA Class 5-A design, materials, and construction.

D. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

C. Fire-Rated Door Frame Assemblies, where indicated: 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.
1. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.
2. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.

D. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.

1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify 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 standard steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate installation of anchorages for standard steel frames. 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. Ceco Door Products; an ASSA ABLOY Group Company.
2. CURRIES Company; an ASSA ABLOY Group Company.
3. Fleming Door Products Ltd.; an ASSA ABLOY Group Company.
4. Mesker Door Inc.
5. Pioneer Industries, Inc.
6. Steelcraft; an Ingersoll-Rand Company.

B. GSA Approved Class 5-A Security Vault

1. Hamilton Products Group, Inc.
2. Approved equal.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 (ZF180) zinc-iron-alloy (galvannealed) coating designation.

D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized.

E. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.

G. 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 standard steel door frames of type indicated.

H. Grout: Comply with Division 4 Section "Unit Masonry Assemblies."

I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.

J. Glazing: Comply with requirements in Division 8 Section "Glazing."

K. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD STEEL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.

    a. Fire Door Core, where indicated: As required to provide fire-protection and temperature-rise ratings indicated.
    b. Thermal-Rated (Insulated) Doors,where indicated: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x sq. ft./Btu (0.704 K x sq. m/W) when tested according to ASTM C 1363.

        1) Locations: Exterior doors and interior doors where indicated.

3. Vertical Edges for Single-Acting Doors: Beveled edge.

    a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).

4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick end closures or channels of same material as face sheets.
6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet, minimum 16 gauge. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
   1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet, minimum 18 gauge, unless otherwise indicated to comply with exterior door requirements. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
   1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).

D. 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. Pivots: Minimum 0.167 inch (4.2 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.
   3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch (1.7 mm) thick.
   4. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated steel sheet, minimum 14gauge.

   1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
   2. Frames for Level 3 Steel Doors: 0.067-inch- (1.7-mm-) thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet, minimum 16 gauge, unless otherwise indicated to comply with exterior frame and door requirements.

   1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
   2. Frames for Level 3 Steel Doors: 0.067-inch- (1.7-mm-) thick steel sheet.
   3. Frames for Wood Doors: 0.067-inch- (1.7-mm-) thick steel sheet.

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. Pivots: Minimum 0.167 inch (4.2 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.
   3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch (1.7 mm) thick.

4. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.

E. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.

F. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Compression Type for Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

I. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch- (9.5-mm-thick by 50-mm-) wide steel.

J. Plaster Guards: Formed from same material as frames, not less than 0.016-inch (0.4-mm) thick.

2.5 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch (16 mm) high, unless otherwise indicated.

2.6 FABRICATION

A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Standard Steel Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.

C. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
3. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

        1) Two anchors per jamb up to 60 inches (1524 mm) in height.
        2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
        3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) in height.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 120 inches (3048 mm) in height.

    b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

        1) Three anchors per jamb up to 60 inches (1524 mm) in height.
        2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
        3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) in height.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 96 inches (2438 mm) in height.
        5) Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal-stud partitions.

    c. Compression Type: Not less than two anchors in each jamb.
    d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."

1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware.
2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

E. 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 door or frame.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings such that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of doors and frames.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.7 STEEL FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish standard steel door and frames after assembly.

B. Metallic-Coated Steel 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.

C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils (0.018 mm).

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint

system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

2.8 GSA Approved Class 5-A Armory Door

A. Federal Specification AA-D-500.

B. Federal Lock Specification AA-D-655.

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 standard steel doors and frames.

1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.
2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory.

B. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. 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.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
3. 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.
4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Standard Steel Frames: Install standard steel frames for doors, sidelights and other openings, of size and profile indicated. Comply with SDI 105.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections due to 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 plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Install grout in lifts and take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
9. Installation Tolerances: Adjust standard steel 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. Standard Steel 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 8 Section "Glazing" and with standard steel door and frame 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.

E. Install GSA Approved Class 5–A Armory Vault Door, Frame and Lock according to Federal Specification requirements and all manufacturer written instructions and recommendations.

1. Refer to drawings for vault door size and location.
2. Coordinate with manufacturer for all installation requirements.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

D. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08111

SECTION 08211 - 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 minimum 1/16" wood-veneer, faces.
2. Factory finishing flush wood doors.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 8 Section "Standard Steel Doors and Frames" 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 and trim for openings. Include factory-finishing specifications.

B. 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.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

D. SPiRiT Submittals:

1. Certificates for Credit MR 4.C4: Recycled material certificates certifying that flush wood doors comply with recycled wood content requirements.

2. Product Data for Credit IEQ 5.C4: For adhesives and composite wood products, indicating that product contains no urea formaldehyde.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: Comply with NWWDA I.S.1-A, "Architectural Wood Flush Doors".

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

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. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 75-mm) span.

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 from date of Substantial Completion:
   a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flush Wood Doors:

   a. Ampco Products, Inc.
   b. Buell Door Company.
   c. GRAHAM Manufacturing Corp.
   d. IPIK Door Company.

e. Marlite.
f. Mohawk Flush Doors, Inc.
g. Poncraft Door Co.
h. Southwood Door Co.
i. Weyerhaeuser Company.
j. Daly, prefinished Wood Doors.
k. VT Industries, Architectural Wood Doors.

2.2 DOOR CONSTRUCTION, GENERAL

A. Doors for Transparent Finish:

1. Grade: Premium, with Grade AA faces.
2. Species and Cut: Cherry.
3. Match between Veneer Leaves: Book match.

B. Adhesives: Do not use adhesives containing urea formaldehyde.

2.3 SOLID-CORE DOORS

A. Interior Veneer-Faced Doors:

1. Core: Either glued block or structural composite lumber.
2. Construction: Five or seven plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.
3. Construction: Seven plies, either bonded or nonbonded construction.

2.4 LOUVERS AND LIGHT FRAMES

A. Metal Louvers, where indicated: Door manufacturer's standard pre-finished metal louvers, unless otherwise indicated.

2.5 FABRICATION

A. Fabricate doors in sizes indicated for Project-site fitting.

B. 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 in NFPA 80 for fire-rated doors.

C. 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.

D. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.

1. Louvers: Factory install louvers in prepared openings.

2.6 FACTORY FINISHING

A. General: Comply with WIC's "Manual of Millwork" for factory finishing.

B. Finish doors at factory.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: NWWDA I.S.1-A System TR-6 catalyzed polyurethane.
3. Staining: As selected by Architect from manufacturer's full range.
4. Effect: Semifilled finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and 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 level heads and plumb jambs.
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 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. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold.

a. Comply with NFPA 80 for fire-rated doors.

2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
3. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08211

SECTION 08311 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing 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. Wall access doors and frames.
2. Ceiling access doors and frames.

B. Related Sections include the following:

1. Division 8 Section "Door Hardware" for mortise or rim cylinder locks and master keying.
2. Division 9 Section "Acoustical Panel Ceilings" for access tile in suspended acoustical tile ceilings.
3. Division 15 Section "Duct Accessories" for heating and air-conditioning duct access doors.

1.3 SUBMITTALS

A. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.

B. Shop Drawings: Show fabrication and installation details of customized doors and frames. Include plans, elevations, sections, details, and attachments to other Work.

C. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:

1. Method of attaching door frames to surrounding construction.
2. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain doors and frames through one source from a single manufacturer.

B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article.

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Access Doors:

a. Acudor Products, Inc.
b. Bar-Co, Inc. Div.; Alfab, Inc.
c. Cendrex, Inc.
d. Cesco Products.
e. Elmdor/Stoneman; Div. of Acorn Engineering Co.
f. Jensen Industries.
g. J. L. Industries, Inc.
h. Karp Associates, Inc.
i. Larsen's Manufacturing Company.
j. MIFAB Manufacturing, Inc.
k. Milcor Limited Partnership.
l. Nystrom Building Products Co.
m. Precision Plumbing Products, Inc.
n. Williams Bros. Corporation of America (The).

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), with Class C coating and phosphate treatment to prepare surface for painting; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M for uncoated base metal.

C. Drywall Beads: Edge trim formed from 0.0299-inch (0.76-mm) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.3 PAINT

A. Shop Primers: Provide primers that comply with Division 9 Section "Painting."

B. Shop Primer for Metallic-Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat.

2.4 ACCESS DOORS AND FRAMES

A. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel or metallic-coated steel sheet, where not required to be Fire-Rated.

1. Locations: Where required at Ceramic-tile and drywall wall and ceiling surfaces.
2. Door: Minimum 0.060-inch- (1.5-mm-) thick sheet metal, set flush with exposed face flange of frame.
3. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with 1-inch- (25-mm-) wide, surface-mounted trim.
4. Hinges: Continuous piano hinge.
5. Lock: Key-operated cylinder lock.

B. Exterior Flush Access Doors and Frames with Exposed Trim: Weatherproof with extruded door gasket.

1. Locations: Exterior wall surfaces as indicated.
2. Door: Minimum 0.040-inch- (1.0-mm-) thick, metallic-coated steel sheet; flush panel construction with manufacturer's standard 2-inch- (50-mm-) thick fiberglass insulation.
3. Frame: Minimum 0.060-inch- (1.5-mm-) thick extruded aluminum.
4. Hinges: Continuous piano, zinc plated.
5. Lock: Dual-action handles with key lock.

2.5 FABRICATION

A. General: Provide access door assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces 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.

C. Steel Doors and Frames: Grind exposed 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 Flanges: As indicated.
2. Provide mounting holes in frames to attach frames to metal or wood framing in plaster and drywall construction and to attach masonry anchors in masonry construction.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder lock, furnish two keys per lock and key all locks alike.

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. Finish metal fabrications after assembly.

2.7 METALLIC-COATED STEEL FINISHES

A. Galvanizing of Steel Shapes and Plates: Hot-dip galvanize items indicated to comply with applicable standard listed below:

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For metallic-coated surfaces, 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.

C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after cleaning and pretreating.

2.8 STEEL FINISHES

A. Surface Preparation: 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."

B. Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

PART 3 - EXECUTION

3.1 PREPARATION

A. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

3.3 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08311

SECTION 08331 - OVERHEAD COILING 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 manually and electric-motor-operated overhead coiling doors:

1. Counter doors.
2. Insulated service doors.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for SPiRiT requirements.
2. Division 5 Section "Metal Fabrications" for miscellaneous steel supports.
3. Division 8 Section "Door Hardware" for lock cylinders and keying.
4. Division 9 Section "Painting" for field-applied paint finish.
5. Division 16 Sections for electrical service and connections for powered operators and accessories.

1.3 DEFINITIONS

A. Operation Cycle: One complete cycle of a door begins with the door in the closed position. The door is then moved to the open position and back to the closed position.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:

B. Operation-Cycle Requirements: Design overhead coiling door components and operator to operate for not less than 20,000 cycles.

1.5 SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes. Provide roughing-in diagrams, operating instructions, and maintenance information. Include the following:

1. Setting drawings, templates, and installation instructions for built-in or embedded anchor devices.
2. Summary of forces and loads on walls and jambs.
3. Motors: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.

B. Samples for Verification: Of each type of exposed finish required, prepared on Samples of size indicated below and of same thickness and material indicated for Work. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

1. Curtain Slats: 12-inch (300-mm) length.
2. Bottom Bar: 6-inch (150-mm) length.
3. Guides: 6-inch (150-mm) length.
4. Brackets: 6 inches (150 mm) square.
5. Hood: 6 inches (150 mm) square.

C. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the overhead coiling door manufacturer for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain overhead coiling doors through one source from a single manufacturer.

1. Obtain operators and controls from the overhead coiling door manufacturer.

C. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

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. The Cookson Company.
2. McKeon Rolling Steel Door Company, Inc.
3. Overhead Door Corporation.
4. Raynor Garage Doors.
5. Roll-Lite Door Corp.; Div. of Clopay Building Products Co.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtain: Fabricate overhead coiling door curtain of interlocking slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of material thickness recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Structural-quality, cold-rolled galvanized steel sheets complying with ASTM A 653, with G90 (ASTM A 653M, with Z275) zinc coating.
2. Inside Curtain Slat Face: To match material of outside metal curtain slat and as follows:

a. Galvanized Steel Sheet Thickness: Not less than 0.028 inch (0.7 mm).

3. Stainless-Steel Door Curtain Slats, where indicated: ASTM A 666, Type 304.

a. Minimum Specified Thickness: Not less than 0.025 inch (0.65 mm).
b. Flat profile slats.
c. Perforated slats, 25 percent of total door opening.
d. Fenestrated slats, 17 percent of total door opening.
e. Vision windows, 10 by 1-5/8 inches (254 by 38 mm), spaced 2 inches (51 mm) apart and 12 inches (305 mm) from end guides; in 2 rows of slats.

4. Insulation: Fill slat with manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within metal slat faces.

B. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

C. Endlocks for Counter Doors: Manufacturer's standard locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

D. Bottom Bar for Service Doors: Consisting of 2 angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; galvanized, stainless-steel, or aluminum extrusions to suit type of curtain slats.

E. Bottom Bar for Counter Doors: Manufacturer's standard continuous channel or tubular shape, either stainless-steel or aluminum extrusions to suit type of curtain slats.

1. Astragal: Provide a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene; for placement between angles or fitted to shape, as a cushion bumper for interior door.

F. Curtain Jamb Guides for Service Doors: Fabricate curtain jamb guides of steel angles or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Build up units with not less than 3/16-inch- (5-mm-) thick galvanized steel sections complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

G. Curtain Jamb Guides for Counter Doors: Fabricate curtain jamb guides of angles or channels and angles, or stainless-steel sheet or material and finish to match curtain slats, as indicated,

with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. 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.

1. Removable Posts and Jamb Guides: Manufacturer's standard.

2.3 HOODS AND ACCESSORIES

A. Hood: Form to entirely enclose coiled curtain and operating mechanism at opening head and act as weatherseal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.

1. Fabricate steel hoods, for steel doors, of not less than 0.028-inch (0.7-mm) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653 (ASTM A 653M).
2. Shape: Square.

B. Integral Sills: Fabricate sills as integral part of frame assembly of same sheet metal, but not less than 0.078 inch (2.0 mm) thick.

C. Push/Pull Handles: For push-up-operated or emergency-operated doors, provide galvanized steel lifting handles on each side of door.

1. Provide pull-down straps or pole hooks for doors more than 84 inches (2130 mm) high.

D. Slide Bolt: Fabricate with side locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

E. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.

1. Locking Bars: Single-jamb side, operable from inside only.

F. Where door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.

G. Provide automatic-closing device inoperative during normal door operations, with governor unit complying with requirements of NFPA 80, with easily tested and reset release mechanism, and designed to be activated by the following:

1. Governor: Oscillating type.
2. Temperature rise and melting point of 165 deg F (74 deg C) replaceable fusible links, interconnected and on both sides of wall of door opening.

2.4 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of adjustable-tension steel helical torsion spring, mounted around a steel shaft and contained in a spring barrel connected to door curtain with

required barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Provide spring balance of 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. Provide cast-steel barrel plugs to secure ends of springs to barrel and shaft.

D. Fabricate torsion rod for counterbalance shaft of cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Provide mounting brackets of manufacturer's standard design, either cast-iron or cold-rolled steel plate with bell-mouth guide groove for curtain.

2.5 MANUAL DOOR OPERATORS

A. Provide manual operators unless electric door operators are indicated.

B. Push-up Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lbf (111 N).

C. Crank-Hoist Operator, where indicated: Provide crank-hoist operator consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit. Size gears to require no more than 35-lbf (155-N) force to turn crank. Fabricate gearbox to be oil tight and completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

1. Provide manufacturer's standard removable operating arm for each crank-gear unit.
2. Provide through-wall shaft operator.

2.6 ELECTRIC DOOR OPERATORS

A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycle requirements specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

B. Comply with NFPA 70.

C. Disconnect Device: Provide hand-operated disconnect or mechanism for automatically engaging chain and sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

D. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.

E. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, ac or dc.

F. Door-Operator Type: Provide wall-, hood-, or bracket-mounted, jackshaft-type door operator unit consisting of electric motor, enclosed gear-head-reduction drive, and chain and sprocket secondary drive.

1. Through-wall-mounted motor operator.

G. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors complying with NEMA MG 1; with overload protection; sized to start, accelerate, and operate door in either direction from any position, at not less than 2/3 fps (0.2 m/s) and not more than 1 fps (0.3 m/s), without exceeding nameplate ratings or service factor.

1. Type: Polyphase, medium-induction type.
2. Service Factor: According to NEMA MG 1, unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
4. Provide open dripproof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.
5. Provide totally enclosed, nonventilated or fan-cooled motor, fitted with plugged drain, and controller with NEMA ICS 6, Type 4 enclosure where indicated.

H. Remote-Control Station: Provide momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."

1. Provide interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. Provide exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

I. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.

2. Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

a. Provide electrically actuated automatic bottom bar.

1) Self-Monitoring Type: Four-wire configured device.

J. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

K. Provide electric operators with ADA-compliant audible alarm and visual indicator lights.

2.7 FINISHES, GENERAL

A. General: 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. Powder-Coat-Applied Finish: Apply manufacturer's standard powder-coat-applied finish consisting of primer and topcoat(s) according to coating manufacturer's written instructions for cleaning, pretreatment, application, thermosetting, and minimum dry film thickness.
1. Color and Gloss: As selected by Architect from manufacturer's full range of colors and glosses.

2.9 STAINLESS-STEEL FINISHES

A. General: Remove or blend stretch lines and tool and die marks into finish.

1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. Bright, Directional Polish: No. 4 finish.

C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install door and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's written instructions, and as specified.

3.2 ADJUSTING

A. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.

3.3 DEMONSTRATION

A. Startup Services: Engage a factory-authorized service representative to perform startup services and to train Owner's maintenance personnel as specified below:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Test door closing when activated by detector or alarm connected fire-release system. Reset door-closing mechanism after successful test.

2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance, and procedures for testing and resetting release devices.
3. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."
4. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
5. Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 08331

SECTION 08411 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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. Exterior aluminum-framed storefronts.

    a. Glazing is retained mechanically with gaskets on four sides.

2. Exterior manual-swing aluminum doors.

3. Exterior aluminum door frames.

B. Related Sections include the following:

1. Division 7 Section "Joint Sealants" for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
2. Division 8 Section "Door Hardware" for hardware to the extent not specified in this Section.
3. Division 8 Section "Glazing" for glazing requirements to the extent not specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. 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.
g. Failure of operating units to function properly.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Seismic Loads: As indicated on Drawings.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller] [amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below to less than 1/8 inch (3.2 mm) and clearance between members and operable units directly below to less than 1/16 inch (1.5 mm).

D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity but not less than 10 seconds.

E. Story Drift: Provide aluminum-framed systems that accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings.
2. Test Performance: Meeting criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times design displacement.

F. Thermal Movements: Provide aluminum-framed 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; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

a. Test High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
b. Test Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).

G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas 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 difference of 1.57 lbf/sq. ft. (75 Pa).

H. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

1. Maximum Water Leakage: No uncontrolled water penetrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.

I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.

J. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) when tested according to AAMA 1503.

K. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having minimum STC **32** according to ASTM E 413 and an OITC 26 according to ASTM E 1332, as determined by testing according to ASTM E 90.

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. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
3. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Welding certificates.

D. Qualification Data: For Installer and testing agency.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.

F. Field quality-control test and inspection reports.

G. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

H. 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 and who is acceptable to manufacturer.

1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.

B. 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.

C. Accessible Entrances: Comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." ICC/ANSI A117.1. [FED-STD-795, "Uniform Federal Accessibility Standards."

D. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

E. Structural-Sealant Glazing: Comply with recommendations in ASTM C 1401, "Guide for Structural Sealant Glazing."

F. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

G. 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.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed 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. Adhesive or cohesive sealant failures.
e. Water leakage through fixed glazing and framing areas.
f. Failure of operating components to function properly.

2. Warranty Period: 10 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: 20 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 aluminum-framed systems is based on Kawneer, Trifab 451, with thermally broken frames. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. Arch Aluminum & Glass Co., Inc.
2. CMI Architectural Products, Inc.
3. Commercial Architectural Products, Inc.
4. EFCO Corporation.
5. Kawneer.
6. Tubelite Inc.
7. United States Aluminum.
8. Vistawall Architectural Products.

2.2 MATERIALS

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, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. 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. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by an elastomeric material of low thermal conductance] [Framing members are one-piece members that are internally slotted at regular intervals] [High-performance plastic connectors separate framing members exposed to the exterior from members exposed to the interior.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. 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 turning 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, finished to match framing system , fabricated from stainless steel.

D. 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.

E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 8 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

1. Glazing Sealants:

a. Color: Black.

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 aluminum-framed system manufacturers for this use.

a. Color: Matching structural sealant.

2.5 DOORS

A. Doors: Manufacturer's standard glazed doors, for manual swing operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Medium stile; 3-1/2-inch (88.9-mm) nominal width.

a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

B. Door Hardware: As specified in Division 8 Section "Door Hardware."

2.6 DOOR HARDWARE

A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.

1. Opening-Force Requirements:

a. Egress Doors: Not more than 30 lbf (133 N) required to set door in motion and not more than 15 lbf (67 N) required to open door to minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf (22.2 N).

B. Scheduled Door Hardware: Provide door hardware according to the Door Hardware Schedule at the end of Part 3.
a. Named products are basis-of-design products. Provide named hardware manufacturer's products or comparable products that are equivalent in function and quality and that are recommended and supplied by entrance system manufacturer.

2. References to BHMA Standards: Provide products complying with standards referenced in this Article and with requirements for description, quality, type, and function listed in the Door Hardware Schedule at the end of Part 3.

C. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles; fabricated to full height of door and frame.

D. Locking Devices, General: Do not require use of key, tool, or special knowledge for operation.

1. Opening-Force Requirements:

a. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf (67 N) for not more than 3 seconds.
b. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.

E. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.

F. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

1. Standard: BHMA A156.3, Grade 1.

G. Cylinders: As indicated and specified in Division 8 Section "Door Hardware."

1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE".

H. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

I. Operating Trim: BHMA A156.6.

J. Closers: With accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use, and adjustable to meet field conditions and requirements for opening force.

1. Standard: BHMA A156.4, Grade 1.

K. Concealed Overhead Holders: BHMA A156.8, Grade 1.

L. Surface-Mounted Holders: BHMA A156.16, Grade 1.

M. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

N. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

O. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

P. Silencers: BHMA A156.16, Grade 1.

Q. Thresholds: Raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).

1. Standard: BHMA A156.21.

R. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.7 ACCESSORY MATERIALS

A. Insulating Materials: As specified in Division 7 Section "Building Insulation."

B. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."

C. 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.

2.8 FABRICATION

A. Form aluminum shapes before finishing.

B. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. 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 maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

D. Storefront Framing: Fabricate components for assembly using head-and-sill-receptor system with shear blocks at intermediate horizontal members.

E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

F. Doors: Reinforce doors as required for installing hardware.

1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 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. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; 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.

1. Color: Dark bronze.

2.10 SOURCE QUALITY CONTROL

A. Structural-Sealant-Glazed Systems: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, system material qualification procedures, sealant testing, and system fabrication reviews and checks.

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. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. 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. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, without warp or rack.

F. Install glazing as specified in Division 8 Section "Glazing."

G. Entrances: Install to produce smooth operation and tight fit at contact points.

1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

I. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
2. Alignment:

a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch (3 mm).

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

C. 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. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.

1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch measured to the leading door edge.

END OF SECTION 08411

SECTION 08711 - DOOR HARDWARE (SCHEDULED BY NAMING PRODUCTS)

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. Commercial door hardware for the following:

a. Swinging doors.
b. Other doors to the extent indicated.

2. Cylinders for doors specified in other Sections.

B. Related Sections include the following:

1. Division 8 Section "Standard Steel Doors and Frames" for door silencers provided as part of the frame.
2. Division 8 Section "Flush Wood Doors" for wood doors installed in hollow metal frames.
3. Division 8 Section "Access Doors" for access door hardware, except cylinders.

C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

1. Final replacement cores and keys to be installed by Owner.

1.3 SUBMITTALS

A. Product Data: Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.

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 door hardware indicated.

C. Samples: For exposed door hardware of each type indicated below, in specified finish, full size. Tag with full description for coordination with the Door Hardware Schedule. Submit samples before, or concurrent with, submission of the final Door Hardware Schedule.

1. Door Hardware: As follows:

a. As requested by Architect.

2. 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. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.

    a. Organize door hardware sets in same order as in the Door Hardware Schedule at the end of Part 3.

3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the 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 Schedule.

E. Keying Schedule: Prepared by or under the supervision of supplier, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

F. Product Certificates: Signed by manufacturers of electrified door hardware certifying that products furnished comply with requirements.

1. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.

G. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

1. Include lists of completed projects with project names and addresses of architects and owners, and other information specified.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, indicating current products comply with requirements.

I. Maintenance Data: For each type of door hardware to include in maintenance manuals specified in Division 1.

J. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed door hardware 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. Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

C. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute 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.

D. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

E. Regulatory Requirements: Comply with provisions of the following:

1. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1, [FED-STD-795, "Uniform Federal Accessibility Standards," as follows:

a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
b. Door Closers: Comply with the following maximum opening-force requirements indicated:

1) Interior Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
2) Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
3) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

c. Thresholds: Not more than 1/2 inch (13 mm) high.

2. NFPA 101: Comply with the following for means of egress doors:

a. Latches, Locks, and Exit Devices: Not more than 15 lbf (67 N) to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
b. Door Closers: Not more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.
c. Thresholds: Not more than 1/2 inch (13 mm) high.

F. Keying Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings." Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2. Preliminary key system schematic diagram.
3. Requirements for key control system.
4. Address for delivery of keys.

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. 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 Schedule, and include basic installation instructions with each item or package.

C. Deliver keys to manufacturer of key control system.

D. Deliver keys to Owner by registered mail or overnight package service.

1.6 COORDINATION

A. Coordinate layout and installation of recessed pivots and closers with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

B. Templates: Obtain and distribute to the parties involved 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 Owner's Project Manager for all Owner cylinder and keying requirements.

1.7 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 Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of operators and door hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

C. Warranty Period for exit devices: Three years from date of Substantial Completion, unless otherwise indicated.

D. Warranty Period for locksets: Seven years from date of substantial completion.

E. Warranty Period for Manual Closers: Ten 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.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section and the Door Hardware Schedule at the end of Part 3.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Schedule at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

2.2 HINGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hinges:
   a. Bommer Industries, Inc. (BI).
   b. Hager Companies (HAG).
   c. H.B.Ives
   d. McKinney Products Company; An ASSA ABLOY Company.
   e. Approved Equal.

B. Standards: Comply with the following:

1. Butts and Hinges: BHMA A156.1.

2. Template Hinge Dimensions: BHMA A156.7.

C. Quantity: Provide the following, unless otherwise indicated:

1. Two Hinges: For doors with heights up to 60 inches (1524 mm).
2. Three Hinges: For doors with heights 61 to 90 inches (1549 to 2286 mm).

D. Template Requirements: Provide only template-produced units.

E. Hinge Weight: Unless otherwise indicated, provide the following:

1. Entrance Doors: Standard-weight, antifriction-bearing hinges.
2. Doors with Closers: Antifriction-bearing hinges.
3. Interior Doors: Standard-weight hinges.
4. Fire-rated openings: Antifriction-bearing hinges.

F. 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.

G. Hinge Options: Comply with the following and where indicated in the Door Hardware Schedule or on Drawings:

1. 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 the following applications:

a. Outswinging exterior doors.
b. Outswinging corridor doors with locks.

2. Corners: Square.

H. 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.
4. Screws: Phillips flat-head screws; machine screws for metal doors and wood screws for wood doors and frames. Finish screw heads to match surface of hinges.

2.3 LOCKS AND LATCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mechanical Locks and Latches:

a. Best Lock Corporation (BLC).
b. Corbin Russwin Architectural Hardware; Div. of Yale Security Inc. (CR).
c. Sargent Manufacturing Company (SAR).

d. Schlage Lock Company; an Ingersoll-Rand Company (SCH).
e. Approved Equal.

B. Standards: Comply with the following:

1. Bored Locks and Latches: BHMA A156.2.
2. Mortise Locks and Latches: BHMA A156.13.

C. Bored Locks: BHMA Grade 1 Series 4000.

D. Mortise Locks: Stamped steel case with steel or brass parts; BHMA Grade 1 Series 1000.

E. Certified Products: Provide door hardware listed in the following BHMA directories:

1. Mechanical Locks and Latches: BHMA's "Directory of Certified Locks & Latches."

F. Lock Trim: Comply with the following:

1. Lever: Die cast.
2. Escutcheon (Rose): Wrought.
3. Lockset Designs: Provide the lockset design designated below or, if sets are provided by another manufacturer, provide designs that match those designated:

a. Bored Locks: Corbin Ruswwin CL3300 Series, Sargent 10-Line, Schlage ND Series or Best 93K.

G. Lock Functions: Function numbers and descriptions indicated in the Door Hardware Schedule comply with the following:

1. Bored Locks: BHMA A156.2.
2. Mortise Locks: BHMA A156.13.

H. Lock Throw: Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:

1. Bored Locks: Minimum 1/2-inch (12.7-mm) latchbolt throw.
2. Deadbolts: Minimum 1-inch (25-mm) bolt throw.

I. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

2.4 EXIT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Corbin Russwin Architectural Hardware.
2. Precision Hardware, Inc. (PH). Apex Series.
3. Sargent Manufacturing Company; Div. of ESSEX Industries, Inc. (SGT). 8000 Series.
4. Von Duprin; an Ingersoll-Rand Company (VD). 99/98 Series.
5. Approved Equal.

B. Standard: BHMA A156.3.

1. BHMA Grade: Grade 1.

C. Certified Products: Provide exit devices listed in BHMA's "Directory of Certified Exit Devices."

D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

E. Fire Exit Devices: Complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

F. Outside Trim: Lever; material and finish to match locksets, unless otherwise indicated.

1. Match design for locksets and latchsets, unless otherwise indicated.

G. Through Bolts: For exit devices and trim on metal doors and fire-rated wood doors.

2.5 CYLINDERS AND KEYING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cylinders: Match Owner's existing key section and cylinder type.

B. Standards: Comply with the following:

1. Cylinders: BHMA A156.5.

C. Cylinder Grade: BHMA Grade 1.

D. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Match existing.
2. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
3. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
4. Bored-Lock Type: Cylinders with tailpieces to suit locks.

a. High-Security Grade: BHMA Grade 1A, listed and labeled as complying with pick- and drill-resistant testing requirements of UL 437 (Suffix A).

E. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:

F. Construction Keying: Comply with the following:

1. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

a. Replace construction cores with permanent cores, as directed by Owner.
b. Furnish permanent cores to Owner for installation.

G. Keying System: Unless otherwise indicated, provide a factory-registered keying system complying with the following requirements:

1. Existing System: Master key or grand master key locks to Owner's existing system.
2. Cylinders shall be master keyed or grand master keyed as directed by Owner.

H. Keys: Provide nickel-silver keys complying with the following:

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by Owner.

2. Quantity: In addition to one extra blank key for each lock, provide the following:

a. Cylinder Change Keys: Three.
b. Master Keys: Five.
c. Grand Master Keys: Five.
d. Great-Grand Master Keys: Five.

I. Key Control System: BHMA Grade 1 system, including key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers. Contain system in metal cabinet with baked-enamel finish.

1. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
2. Capacity: Able to hold keys for 150 percent of the number of locks.
3. Cross-Index System: Set up by key control manufacturer, complying with the following:

a. Card Index: Furnish four sets of index cards for recording key information. Include three receipt forms for each key-holding hook.

2.6 STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

2.7 CLOSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Surface-Mounted Closers:

a. Norton Door Controls; An ASSA ABLOY Company.
b. LCN Closers; an Ingersoll-Rand Company.
c. Corbin Russwin Architectural Hardware; An ASSA ABLOY Company.
d. Sargent Manufacturing Company; An ASSA ABLOY Company.
e. Approved Equal.

B. Standards: Comply with the following:

1. Closers: BHMA A156.4.

C. Surface Closers: BHMA Grade 1.

D. Certified Products: Provide door closers listed in BHMA's "Directory of Certified Door Closers."

E. 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.

2.8 PROTECTIVE TRIM UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. H.B. Ives; an Ingersoll-Rand Company.
2. Hager Companies.
3. Trimco.
4. McKinney Products Company; An ASSA ABLOY Company.
5. Triangle Brass Manufacturing Company, Inc. (TBM).
6. Approved Equal.

B. Standard: Comply with BHMA A156.6.

C. Materials: Fabricate protection plates from the following:

1. Stainless Steel: 0.050 inch (1.3 mm) thick; beveled top and 2 sides.

a. Color and Texture: As indicated by manufacturer's designations.

D. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine or self-tapping screws.

E. Furnish protection plates sized 2 inches less than door width on push side and 1 inch less than door width on pull side, by height specified in Door Hardware Schedule.

2.9 STOPS AND HOLDERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. H.B. Ives; an Ingersoll-Rand Company.

2. Hager Companies.
3. Trimco.
4. Don-Jo Manufacturing.
5. McKinney Products Company; An ASSA ABLOY Company.
6. Triangle Brass Manufacturing Company, Inc. (TBM).
7. Approved Equal.

B. Standards: Comply with the following:

1. Stops and Bumpers: BHMA A156.16.
2. Door Silencers: BHMA A156.16.

C. Stops and Bumpers: BHMA Grade 1.

D. Floor Stops: For doors, unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic.

1. Where floor or wall stops are not appropriate, provide overhead holders.

E. Silencers for Metal Door Frames: BHMA Grade 1; neoprene or rubber, minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame.

2.10 DOOR GASKETING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Door Gasketing:

a. Pemko Manufacturing Co., Inc.
b. National Guard Products
c. Hager Companies.
d. McKinney Products Company; An ASSA ABLOY Company.
e. Zero International, Inc. (ZRO).
f. Approved Equal.

2. Door Bottoms:

a. Pemko Manufacturing Co., Inc.
b. National Guard Products
c. Hager Companies.
d. McKinney Products Company; An ASSA ABLOY Company.
e. Zero International, Inc. (ZRO).
f. Approved Equal.

B. Standard: Comply with BHMA A156.22.

C. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

D. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.

E. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.

1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

F. Fire-Labeled Gasketing: 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 UL 10B or NFPA 252.

G. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

H. Gasketing Materials: Comply with ASTM D 2000 and AAMA 701/702.

2.11 THRESHOLDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Pemko Manufacturing Co., Inc.
b. National Guard Products
c. Hager Companies.
d. McKinney Products Company; An ASSA ABLOY Company.
e. Zero International, Inc. (ZRO).
f. Approved Equal.

B. Standard: Comply with BHMA A156.21.

2.12 FABRICATION

A. Manufacturer's Nameplate: Do not provide manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Steel Machine or Wood Screws: For the following fire-rated applications:

   a. Mortise hinges to doors.
   b. Strike plates to frames.
   c. Closers to doors and frames.

3. Steel Through Bolts: For the following fire-rated applications, unless door blocking is provided:

   a. Surface hinges to doors.
   b. Closers to doors and frames.
   c. Surface-mounted exit devices.

4. Spacers or Sex Bolts: For through bolting of hollow metal doors.
5. Fasteners for Wood Doors: Comply with requirements of DHI WDHS.2, "Recommended Fasteners for Wood Doors."

2.13 FINISHES

A. Standard: Comply with BHMA A156.18.

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. BHMA Designations: Comply with base material and finish requirements indicated by the following:

1. BHMA 626: Satin chromium plated over nickel, over brass or bronze base metal.
2. BHMA 630: Satin stainless steel, over stainless-steel base metal.
3. BHMA 652: Satin chromium plated over nickel, over steel base metal.
4. BHMA 689: Aluminum painted, over any base metal.
5. BHMA 718: Satin aluminum, uncoated; aluminum base metal.

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 SDI 107.

B. Wood Doors: Comply with DHI A115-W series.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically 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."

B. 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 9 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.

C. Key Control System: Place keys on markers and hooks in key control system cabinet, as determined by final keying schedule.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 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. Door Closers: 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. Six-Month Adjustment: Approximately six months after date of Substantial Completion, Installer shall perform the following:

1. Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.
2. Consult with and instruct Owner's personnel on recommended maintenance procedures.
3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

3.6 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 door hardware is without damage or deterioration at time of Substantial Completion.

3.7 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.

3.8 DOOR HARDWARE SCHEDULE

A. See Door Schedule sheet for hardware groups.
END OF SECTION 08711

SECTION 08800 - 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. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Glazed curtain walls.
4. Glazed entrances.
5. Storefront framing.

B. Related Sections include the following:

1. Division 8 Section "Aluminum-Framed Entrances and Storefronts" for glazing requirements of storefront systems.

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

a. Specified Design Wind Loads: As indicated.
b. Specified Design Wind Loads: As indicated, but not less than wind loads applicable to Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads."
c. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour (meters per second) at 33 feet (10 m) above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.

1) Basic Wind Speed: As indicated.
2) Importance Factor: As indicated.
3) Exposure Category: As indicated.

d. Specified Design Snow Loads: As indicated, but not less than snow loads applicable to Project as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7.0, "Snow Loads."
e. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.

1) Load Duration: 60 seconds or less.

f. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less.

1) For monolithic-glass lites heat treated to resist wind loads.
2) For insulating glass.
3) For laminated-glass lites.

g. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. 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.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites minimum 6.0 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units with lites minimum 6.0 mm thick and a nominal 1/2-inch- (12.7-mm-) wide interspace.
4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:

a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).
b. Solar Heat Gain Coefficient: NFRC 200.
c. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass and of 12-inch- (300-mm-) long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

E. Qualification Data: For installers.

F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

G. Product Test Reports: For each of the following types of glazing products, where indicated:

1. Coated float glass.
2. Insulating glass.
3. Glazing sealants.
4. Glazing gaskets.

H. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Glass: Obtain the glass through one source from a single manufacturer for each glass type indicated.

C. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.

D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

E. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.

1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

F. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Sealant 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 glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

G. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

H. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.
2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. (0.84 sq. m) in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. (0.84 sq. m) or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

I. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:

   1. Insulating Glass Certification Council.
   2. Associated Laboratories, Inc.

K. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

   1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

   1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 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 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. 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 GLASS PRODUCTS

A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.

1. Ultra-Clear (Low-Iron) Float Glass: Class I (clear); with a minimum 91 percent visible light transmission and a minimum solar heat gain coefficient of 0.87.

a. Available Products:

1) AFG Industries Inc.; Krystal Klear.
2) Pilkington Building Products North America; Optiwhite.
3) PPG Industries, Inc.; Starphire.
4) Schott Corporation; Amiran.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
3. For uncoated glass, comply with requirements for Condition A.
4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

C. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and complying with other requirements specified.

1. Available Products:

a. PPG Industries, Inc.; SunClean.
b. Pilkington Building Products North America; Activ.

D. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.

1. Provide Kind HS (heat-strengthened) float glass in place of 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 Part 1 "Performance Requirements" Article.
2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
3. Provide passive Solar Low-E Insulating-Glass Units for all exterior lites.
4. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
5. Sealing System: Dual seal, with primary and secondary sealants as follows:

a. Manufacturer's standard sealants.

6. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:

1. Neoprene, ASTM C 864.
2. EPDM, ASTM C 864.
3. Silicone, ASTM C 1115.
4. Thermoplastic polyolefin rubber, ASTM C 1115.
5. Any material indicated above, recommended by manufacturer for application required.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:

1. Neoprene.
2. EPDM.
3. Silicone.
4. Thermoplastic polyolefin rubber.
5. Any material indicated above, recommended by manufacturer for application required.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.4 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

C. Glazing Sealants for Fire-Resistive Glazing Products: Identical to products used in test assemblies to obtain fire-protection rating.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.7 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm) as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08800

SECTION 09260 - 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. Interior gypsum wallboard.
2. Water-resistant gypsum wallboard ceramic tile backing panels.
3. Cement backer board for tile backing panels in showers.
4. Non-load-bearing steel framing.

B. Related Sections include the following:

1. Division 01 Section "Sustainable Design Requirements" for additional SPiRiT requirements that affect gypsum board and related products.
2. Division 7 Section "Building Insulation" for insulation and vapor retarders installed in gypsum board assemblies.
3. Division 9 Section "Ceramic Tile".

1.3 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

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

B. SPiRiT Submittals:

1. For Credit IEQ 5.C4, manufacturers' product data for adhesives used to laminate gypsum board panels to substrates, including printed statement of VOC content.
2. For Credit MR 4.C4, manufacturers' product data for gypsum board panels manufactured with recycled material content.
3. For Credit MR 4.C5, manufacturers' product data for gypsum board panels manufactured within a 500 mile radius, where applicable.

C. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, 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 GA-600, "Fire Resistance Design Manual."

B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."

1.6 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. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

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. Steel Framing and Furring:

a. Clark Steel Framing Systems.
b. Consolidated Systems, Inc.
c. Dale Industries, Inc. - Dale/Incor.
d. Dietrich Industries, Inc.
e. MarinoWare; Division of Ware Ind.
f. National Gypsum Company.
g. Scafco Corporation.
h. Unimast, Inc.
i. Western Metal Lath & Steel Framing Systems.

2. Gypsum Board and Related Products:

   a. American Gypsum Co.
   b. G-P Gypsum Corp.
   c. National Gypsum Company.
   d. United States Gypsum Co.
   e.

2.2 STEEL PARTITION AND SOFFIT FRAMING

A. Components, General: As follows:

1. Comply with ASTM C 754 for conditions indicated.
2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating.

B. Steel Studs and Runners: ASTM C 645.

1. Minimum Base Metal Thickness: 0.027 inch (0.7 mm).
2. Depth: As indicated.

C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges, unless otherwise indicated.

D. Proprietary Deflection Track, at contractor's option: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above; in thickness indicated for studs and in width to accommodate depth of studs.

1. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Delta Star, Inc., Superior Metal Trim; Superior Flex Track System (SFT).
   b. Metal-Lite, Inc.; Slotted Track.

E. Proprietary Firestop Track, at contractor's option: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
   b. Metal-Lite, Inc.; The System.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base Metal Thickness: 0.027 inch (0.7 mm).

G. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flange.

1. Depth: 1-1/2 inches (38.1 mm).
2. Clip Angle: 1-1/2 by 1-1/2 inch (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
2. Depth: 7/8 inch (22.2 mm).

I. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flange.

1. Depth: 3/4 inch (19.1 mm).
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

J. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.3 INTERIOR GYPSUM WALLBOARD

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Gypsum Wallboard: ASTM C 36.

1. Type X:

a. Thickness: 5/8 inch (15.9 mm).
b. Long Edges: Tapered for prefilling.
c. Location: Vertical surfaces, unless otherwise indicated.

2. Type WR:

a. Thickness: 5/8 inch (15.9 mm).
b. Long Edges: Tapered for prefilling.
c. Location: Vertical surfaces, unless otherwise indicated.

2.4 TILE BACKING PANELS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M.

1. Core: As indicated and required to match adjacent substrates, 5/8 inch (15.9 mm), Type X.

C. Cementitious Backer Units: ANSI A108.1.

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. Custom Building Products; Wonderboard.
    b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
    c. USG Corporation; DUROCK Cement Board.

3. Thickness: 1/2 inch (12.7 mm) or as indicated on Drawings.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:

    a. Cornerbead: Use at outside corners, unless otherwise indicated.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
    c. L-Bead: L-shaped; exposed long leg receives joint compound; use where indicated or required.
    d. U-Bead: J-shaped; exposed short flange does not receive joint compound; use at exposed panel edges, or where indicated.
    e. Expansion (Control) Joint: Use where indicated or required by manufacturer's recommendations and product installation instructions.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound, drying-type, all-purpose compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

D. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping and setting-type, sandable topping compounds.
2. Glass-Mat, Water-Resistant Backing Panel: As recommended by manufacturer.
3. Cementitious Backer Units: As recommended by manufacturer.

2.7 ACOUSTICAL SEALANT

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. Acoustical Sealant for Exposed and Concealed Joints:

a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
c. Approved equal.

2. Acoustical Sealant for Concealed Joints:

a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
b. Pecora Corp.; BA-98.
c. Tremco, Inc.; Tremco Acoustical Sealant.
d. Approved equal.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.8 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

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: 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.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

E. Sound Attenuation Blankets: As specified in Division 7 Section "Building Insulation.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

F. Thermal Insulation: As specified in Division 7 Section "Building Insulation."

G. Polyethylene Vapor Retarder: As specified in Division 7 Section "Building Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

1. Furnish concrete inserts and other devises indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (600 mm) o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLING STEEL FRAMING, GENERAL

A. Installation Standards: ASTM C 754, and 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 gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.

a. Use deep-leg deflection track where indicated.
b. Use proprietary deflection track where indicated.
c. Use proprietary firestop track where indicated.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.4 INSTALLING STEEL PARTITION AND CEILING FRAMING

A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.

1. Where studs are installed directly against exterior walls, install asphalt-felt or foam-gasket isolation strip between studs and wall.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not 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. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief.
2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure 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 and to make partitions continuous from floor to underside of solid structure.

a. Terminate partition framing at suspended ceilings where indicated.

D. Install steel studs and furring at the following spacings:

1. Single-Layer Construction: 16 inches (406 mm) o.c., unless otherwise indicated.
2. Multilayer Construction: 16 inches (406 mm) o.c., unless otherwise indicated.
3. Cementitious Backer Units: 16 inches (406 mm) o.c., unless otherwise indicated.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

1. Install two studs at each jamb, unless otherwise indicated.
2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-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.

G. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

H. Polyethylene Vapor Retarder: Install to comply with requirements specified in Division 7 Section "Building Insulation."

3.5 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

B. Install sound attenuation blankets before 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. 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 edge and 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. Do not make joints other than control joints at corners of framed openings.

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. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members using resilient channels, or provide control joints to counteract wood shrinkage.

I. Form control and expansion joints with space between edges of adjoining gypsum panels.

J. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless 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 concrete coffers, concrete joists, and other 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.

K. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. 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.

L. Floating Construction: Where feasible, including where recommended in writing by manufacturer, install gypsum panels over wood framing, with floating internal corner construction.

M. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

N. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.

O. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

3.6 PANEL APPLICATION METHODS

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before 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 (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and 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, unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Install at wet walls, and where indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
2. Areas Not Subject to Wetting: Install standard gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.
3. Cementitious Backer Units: ANSI A108.1, at showers.

F. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.

G. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.7 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.8 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 1: Embed tape at joints in 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 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
3. Level 3: Embed tape and apply separate first and fill coats of joint compound to tape, fasteners, and trim flanges where indicated .
4. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report 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 seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
2. Before 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.

END OF SECTION 09260

SECTION 09310 - CERAMIC TILE

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. Unglazed/glazed floor tile.
2. Glazed wall tile.
3. Stone thresholds installed as part of tile installations.
4. Metal edge strips 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.
2. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Division 9 Section "Gypsum Board Assemblies" for water-resistant backer board and cement backer board.

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).

C. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.
2. Step Treads: Minimum 0.6.
3. Ramp Surfaces: Minimum 0.8.

1.5 SUBMITTALS

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

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches (300 mm) square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.
3. Full-size units of each type of trim and accessory[for each color and finish required].
4. Stone thresholds in 6-inch (150-mm) lengths.
5. Metal edge strips in 6-inch (150-mm) lengths.

D. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile of same color or finish from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. 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.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:

1. Stone thresholds.
2. Metal edge strips.

1.7 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 in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and related materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.9 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. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 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.

B. 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. As selected by Architect from manufacturer's full range.

C. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

A. Available Manufacturers:

1. American Olean; Div. of Dal-Tile International Corp.
2. Daltile; Div. of Dal-Tile International Inc.
3. United States Ceramic Tile.

B. Unglazed Ceramic Mosaic Tile: Factory-mounted flat tile as follows:

1. Composition: Vitreous or impervious natural clay or porcelain.
2. Surface: Slip-resistant, with abrasive admixture.
3. Module Size: 2 by 2 inches (50.8 by 50.8 mm)
4. Nominal Thickness: 1/4 inch (6.35 mm).
5. Face: Plain with cushion edges.

C. Glazed Wall Tile: Flat tile as follows:

1. Module Size: 4-1/4 by 4-1/4 inches (108 by 108 mm).
2. Thickness: 5/16 inch (8 mm).
3. Mounting: Factory back-mounted.

D. Glazed Wall Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
1. Base for Thin-Set Mortar Installations: Straight, module size 4-1/4 by 4-1/4 inches (108 by 108 mm).
2. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size 4-1/4 by 4-1/4 inches (108 by 108 mm).
3. External Corners for Portland Cement Mortar Installations: Bullnose shape with radius of at least 3/4 inch (19 mm), unless otherwise indicated.
4. External Corners for Thin-Set Mortar Installations: Surface bullnose.
5. Internal Corners: Field-butted square corners except with coved base and cap angle pieces designed to fit with stretcher shapes.

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to 1/2 inch (12.7 mm) or less, and finish bevel to match face of threshold.

B. Marble Thresholds: ASTM C 503 with a minimum abrasion resistance of 10 per ASTM C 1353 or ASTM C 241 and with honed finish.
1. Description: Match Architect's sample.

2.4 SETTING AND GROUTING MATERIALS

A. Available Manufacturers:

1. Bostik.
2. LATICRETE International Inc.
3. MAPEI Corporation.

B. Portland Cement Mortar (Thickset—for floors) Installation Materials: ANSI A108.1A and as specified below:

1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.
2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
3. Expanded Metal Lath: Diamond-mesh lath complying with ASTM C 847.

   a. Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication into lath.
   b. Configuration over Studs and Furring: Flat.
   c. Configuration over Solid Surfaces: Self-furring.
   d. Weight: 2.5 lb/sq. yd. (1.4 kg/sq. m).

4. Latex Additive: Manufacturer's standard mulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

C. Latex-Portland Cement Mortar (Thin Set—for walls, unless otherwise noted): ANSI A118.4, consisting of the following:

1. Prepackaged dry-mortar mix containing dry, redispersible, ethylene vinyl acetate additive to which only water must be added at Project site.

   a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.

D. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.

E. Standard Sanded Cement Grout: ANSI A118.6, color as indicated.

F. Standard Unsanded Cement Grout: ANSI A118.6, color as indicated.

2.5 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in 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 extreme temperatures.

1. Available Products:

a. Dow Corning Corporation; Dow Corning 786.
b. GE Silicones; Sanitary 1700.
c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
d. Tremco, Inc.; Tremsil 600 White.

2.6 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. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications, nickel silver exposed-edge material.

C. 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.

D. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.

1. Available Products:

a. Bonsal, W. R., Company; Grout Sealer.
b. Bostik; CeramaSeal Grout Sealer.
c. C-Cure; Penetrating Sealer 978.
d. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout/004, Keraseal Penetrating Sealer for Unglazed Grout and Tile.

2.7 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 of 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 joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of 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.

C. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "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. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form 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 grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are 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 same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. Lay out tile wainscots to next full tile beyond dimensions indicated.

G. 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 in Division 7 Section "Joint Sealants."

H. Grout tile to comply with requirements of the following tile installation standards:

I. For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement;

3.4 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.

1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
   a. Tile floors in wet areas.

B. Joint Widths: Install tile on floors with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).

C. 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.

D. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

E. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

3.5 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Install metal lath and scratch coat for walls to comply with ANSI A108.1A, Section 4.1.

C. Joint Widths: Install tile on walls with the following joint widths:
1. Glazed Wall Tile: 1/16 inch (1.6 mm).

3.6 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. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. When recommended by tile manufacturer, apply 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.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09310

SECTION 09511 - ACOUSTICAL PANEL 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. This Section includes acoustical panels and exposed suspension systems for ceilings.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

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

B. Coordinate Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension members.
2. Method of attaching hangers to building structure.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, and access panels.
4. Minimum Drawing Scale: 1/4 inch = 1 foot (1:48).

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

F. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor type.

G. Maintenance Data: For finishes to include in maintenance manuals.

H. SPiRit Submittals:

1. Credit 5.C4: Manufacturers' product data for sealants, including printed statement of VOC content and material safety data sheets.
2. Credit 4.C4: Recycled content, including manufacturer's printed statement of recycled or post-consumer material content percentages for acoustical panels and metal suspension systems.

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, as documented according to ASTM E 548. 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 Panel: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.

C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class B materials as determined by testing identical products per ASTM E 84:

   a. Smoke-Developed Index: 450 or less.

E. Seismic Standard: Provide acoustical panel 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 C 635.

F. 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. Deliver acoustical panels, 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. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. 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. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION

A. 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.

1.9 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. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.

2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
3. Hold-Down Clips: Equal to 2.0 percent of amount installed.

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. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 ACOUSTICAL PANELS, GENERAL

A. 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 reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: 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.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 CAST OR MOLDED, ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING ACT

A. Available Products:

1. As Scheduled.

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2, Pattern CDK, cast or molded.

C. Color: White.

D. LR: Not less than 0.84.

E. NRC: Not less than 0.55.

F. CAC: Not less than 35.

G. Edge Detail: Square.

H. Thickness: 5/8 inch (15 mm).

I. Size: 24 by 24 inches (610 by 610 mm).

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. 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.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
   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.

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. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch-(1-mm-) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

G. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

H. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING ACT

A. Available Products:

   1. Donn, DX.

B. 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, not less than G30 (Z90) coating designation, with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override type.
3. Face Design: Flat, flush.
4. Cap Material: Steel cold-rolled sheet.
5. Cap Finish: Painted white.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Available Manufacturers:

1. Armstrong World Industries, Inc.
2. Celotex Corporation; Architectural Ceilings Marketing Dept.
3. Chicago Metallic Corporation.
4. Fry Reglet Corporation.
5. USG Interiors, Inc.

B. Roll-Formed 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, finish, and color as that used for exposed flanges of suspension system runners.

2.7 ACOUSTICAL SEALANT

A. Available Products:

1. Acoustical Sealant for Exposed and Concealed Joints:

a. Pecora Corp; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including 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 with requirements for installation tolerances and other conditions affecting performance of acoustical panel 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 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, GENERAL

A. General: Install acoustical panel ceilings to comply with ASTM C 635 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. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. 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.
4. 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.
5. Do not attach hangers to steel deck tabs.
6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
7. 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.

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 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 (3.2 mm in 3.66 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. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Remove and replace acoustical panel ceiling hangers where they do not comply with specified requirements.

3.5 CLEANING

A. 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.

END OF SECTION 09511

SECTION 09651 - RESILIENT FLOOR TILE

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. Vinyl composition tile (VCT).
2. Resilient wall base and accessories.
3. Rubber floor tile.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.

1.3 SUBMITTALS

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

B. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.

1. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long, of each resilient product color and pattern required.

C. Maintenance Data: For resilient products to include in maintenance manuals.

D. SPiRiT Submittals:

1. Credit 5.C4: Manufacturers' product data for adhesives, including printed statement of VOC content.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

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). Store tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. Maintain 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 tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After postinstallation period, maintain 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 48 hours after floor covering installation.

E. Install resilient products after other finishing operations, including painting, have been completed.

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. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
2. Resilient Wall Base and Accessories: 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 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 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 COLORS AND PATTERNS

A. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 VINYL COMPOSITION TILE

A. Vinyl Composition Tile (VCT): ASTM F 1066.

1. Armstrong World Industries, Inc., Arteffects, or Approved Equal .

B. Class: 2 (through-pattern tile).

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch (3.2 mm).

E. Size: 12 by 12 inches (305 by 305 mm).

F. Fire-Test-Response Characteristics:

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

2.4 RESILIENT WALL BASE

A. Wall Base: ASTM F 1861.

1. Roppe Corporation, Black/Brown P-193, or Approved Equal.

B. Type (Material Requirement): TV (vinyl) or TS (rubber, vulcanized thermoset).

C. Group (Manufacturing Method): I (solid).

D. Style: Cove (with top-set toe).

E. Minimum Thickness: 0.125 inch (3.2 mm).

F. Height: 4 inches (102 mm).

G. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.

H. Outside Corners: Premolded.

I. Inside Corners: Job formed or premolded.

J. Surface: Smooth.

2.5 RESILIENT MOLDING ACCESSORY

A. Description: Carpet edge for glue-down applications, Nosing for resilient floor covering, Reducer strip for resilient floor covering, Joiner for tile and carpet.

1. Burke Mercer Flooring Products.
2. Johnsonite.
3. Roppe Corporation.

B. Material: Vinyl or Rubber.

C. Profile and Dimensions: As indicated.

2.6 RESILIENT ATHLETIC FLOOR TILE

A. Basis of Design Product: Subject to compliance with requirements, provide the following Basis of Design product or Approved Equal:

1. Mondo Rubber International, Inc.; Ramflex tiles.
2. Approved Equal.

B. Tile Standard: Prefabricated athletic rubber flooring, calandered and vulcanized with a base of natural and synthetic rubber, stabilizing agents and pigmentation, color selected by architect from manufacturer's standard colors, Marbelized and hammered finish, manufactured in two layers which are vulcanized together. The shore hardness of the top layer will be harder than the bottom layer as recommended by the manufacturer and within the limits specified.

C. Hardness Shore A: Not less than 78/72, measured using Shore, Type A durometer per ASTM D 2240.

D. Wearing Surface: Textured, Molded pattern.

E. Thickness: 3/8 inch (10 mm).

F. Size: 36 by 36 inches (91 cm by 91 cm).

G. Other Physical Properties: 72 Critical Flux, ASTM E 648, NFPA 101; 0.94 W/cm2, Class I; Static Load Limit, ASTM F 970, < 0.004 in.; Fungal Resistance Test; ASTM G 21-90, No Growth; Coefficient of Friction. ASTM D 2047, > 0.9; V.O.C. Compliance ASTM D 5116.

2.7 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product 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. VCT and Asphalt Tile Adhesives: 50 g/L.
b. Cove Base Adhesives: 50 g/L.
c. Rubber Floor Adhesives: 60 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. 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.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
3. Moisture 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 tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. 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.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

1. Do not install resilient products until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

A. Lay out tiles 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 using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).

C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Adhere tiles to flooring 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.

3.4 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Premolded Corners: Install premolded corners before installing straight pieces.

G. Job-Formed Corners:
1. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.5 RESILIENT ACCESSORY INSTALLATION

A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.6 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product 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.

    a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.

    a. Use commercially available product acceptable to manufacturer.
    b. Coordinate selection of floor polish with Owner's maintenance service.

2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09651

SECTION 09681 - CARPET TILE

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.

B. Related Sections include the following:

1. Division 9 Section "Resilient Floor Tile" 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. 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.

C. 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.

D. SPIRIT Submittals:

1. Credit IEQ 5.C4: Manufacturers' product data for carpet tile and installation adhesive, including printed statement of VOC content.
2. Credit MR 4.C4: Manufacturer's product data for carpet tile containing required recycled content.
3. Credit 4.C5: for Local/Regional materials manufacturing.

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.

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 equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Product: Subject to compliance with requirements, provide the following State of Utah Contract Carpet (or approved equal):

1. CP-1: Interface, Kamala; Color to be selected by Architect.

2. Approved equal.

B. Yarn System: 100% DuPont Antron Lumena, or approved equal.

C. Face Construction: Tufted Textured Loop.

D. Tuft Gauge: 1/12

E. Pile Height: .143 inches (4.0 mm) for finished carpet tile per ASTM D 418.

F. Tile size: 50cm x 50 cm GlasBac Tile.

G. Yarn Weight: 23 oz/sq. yd.

H. Backing: GlasBac Tile, or Manufacturer's standard material.

I. GSA Fire Rating: Class A.

J. Performance Characteristics: As follows:
1. Dry Breaking Strength: Not less than 100 lbf (445 N) per ASTM D 2646.
2. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC-165.
3. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per AATCC-16.
4. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC-174.
5. Electrostatic Propensity: Less than 2 kV per AATCC 134.
6. VOC Limits: Provide carpet tile that complies with the following limits for VOC content when tested according to ASTM D 5116:

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.

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. 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.

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.

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 installed 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 09681

SECTION 09900 - 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 of the following:

1. Exposed interior items and surfaces.
2. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. 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.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:

a. Architectural woodwork and casework.
b. Acoustical wall panels.
c. Metal toilet enclosures.
d. Metal lockers.
e. Food Service Equipment.
f. Finished mechanical and electrical equipment.
g. Light fixtures.
h. Distribution cabinets.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

a. Foundation spaces.
b. Furred areas.
c. Ceiling plenums.
d. Pipe spaces.

3. Finished metal surfaces include the following:

   a. Anodized aluminum.
   b. Stainless steel.
   c. Chromium plate.
   d. Copper.
   e. Bronze and brass.

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.

D. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 2 Section "Hot-Mix Asphalt Paving" for traffic-marking paint.
3. Division 2 Section "Portland Cement Concrete Paving" for traffic-marking paint.
4. Division 5 Section "Structural Steel" for shop priming structural steel.
5. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
6. Division 7 Section "Water Repellents" for interior CMU sealer.
7. Division 8 Section "Steel Doors and Frames" for shop priming steel doors and frames.
8. Division 9 Section "Gypsum Board Assemblies" for surface preparation for gypsum board.
9. Division 9 Section "High-Performance Coatings", for surface preparation and application of high-performance coating systems on exterior and interior steel and galvanized steel and epoxy painting of interior gypsum board and CMU in wet locations as indicated.
10. Divisions 15 and 16: Painting of mechanical and electrical work is specified in Divisions 15 and 16, respectively.

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. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

B. 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 block fillers and 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.

C. 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.

D. SPiRiT Submittals: For Credit 5.C4, manufacturers' product data for paints, including printed statement of VOC content and chemical components.

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 block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Comply with procedures specified in PDCA P5. Duplicate finish of approved prepared samples.

1. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.

a. Wall Surfaces: Provide samples on at least 100 sq. ft. (9 sq. m) of wall surface.
b. Small Areas and Items: The Architect will designate an item or area as required.

2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.

a. After finishes are accepted, the Architect will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from job-applied samples.

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 an additional 5 percent, but not less than 1 gal. (3.785 L) or 1 case, as appropriate, of each material and 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.

B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
   1. Benjamin Moore & Co. (Moore).
   2. Pratt & Lambert, Inc. (P & L).
   3. Sherwin-Williams Co. (S-W).
   4. Approved Equal.

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. Material Quality: Provide manufacturer's best-quality 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.

C. Chemical Components 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, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:

   1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
   2. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
   3. 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).
   4. 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. 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. 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. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

    a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
    b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.

3. 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, covers for finned-tube radiation, 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. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. 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. Ductwork.
4. Insulation.
5. Motors and mechanical equipment.
6. Accessory items.

G. Electrical items to be painted include, but are not limited to, the following:

1. Conduit and fittings.

H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

I. 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.

J. 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.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 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.

3.5 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.

3.6 INTERIOR PAINT SCHEDULE

A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.

a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).
1) Moore: Regal First Coat Interior Latex Primer & Underbody #216.
2) P & L: Z/F 1001 Suprime "1" 100 Percent Acrylic Multi-Purpose Primer.

b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).
1) Moore: Moore's Regal AquaGlo Vinyl-Acrylic Latex Enamel #333.
2) P & L: Z/F 4100 Series Accolade Interior Semi-Gloss.

B. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Low-Luster, Acrylic-Enamel Finish: 2 finish coats over a primer.

a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils (0.038 mm).
1) Moore: IronClad Retardo Rust-Inhibitive Paint #163.
2) P & L: S 4551 Tech-Gard High Performance Rust Inhibitor Primer.

b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils (0.071 mm).
1) Moore: Moore's Regal AquaVelvet #319.
2) P & L: Z/F 4000 Series Accolade Interior Velvet.

C. Concrete Substrates, Nontraffic Surfaces:

1. Latex System: MPI INT 3.1E.

a. Prime Coat: Interior latex matching topcoat.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex (eggshell).

D. CMU Substrates:

1. Refer to Division 7 Section "Water Repellents" for interior CMU Sealer.

END OF SECTION 09900

SECTION 09960 - HIGH-PERFORMANCE COATINGS

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 application of high-performance coating systems on the following substrates:

1. Exterior Substrates:

    a. Galvanized metal.

2. Interior Substrates:

    a. Concrete masonry units (CMU) in wet locations, as indicated.
    b. Gypsum board.
    c. Hollow metal doors and frames at wet locations, as indicated.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional SPiRiT requirements.
2. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
3. Division 7 Section "Water Repellents" for Interior CMU not indicated to receive Epoxy paint.
4. Division 9 painting Sections for general field painting.

1.3 SUBMITTALS

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

B. Samples for Initial Selection: For each type of finish-coat product indicated.

C. Samples for Verification: For each type of coating system and in each color and gloss of finish coat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

E. SPIRIT Submittals: For Credit 5.C4, manufacturers' product data for coatings, including printed statement of VOC content and chemical components.

1.4 QUALITY ASSURANCE

A. Master Painters Institute (MPI) Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and coating systems indicated.

B. Mockups: Apply benchmark samples of each coating system indicated 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 type of coating and substrate.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Exterior galvanized steel sun shades.

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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F (10 and 35 deg C), and material substrates remain within acceptable temperatures during coating curing periods.

B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces, or when prohibited conditions are expected during coating curing periods.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

B. Chemical Components of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:

1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
2. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
3. Anticorrosive Coatings: VOC content of not more than 250 g/L.
4. Stains: VOC content of not more than 250 g/L.
5. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing 1 or more benzene rings).
6. 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. Colors: As selected by Architect from manufacturer's full range.

2.2 BLOCK FILLERS

A. Epoxy Block Filler: MPI #116.

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. Columbia Paint & Coatings; Carboline, Carboguard, 954HB; Insl-x, Epoxy Block Filler, EXP 120.
b. Coronado Paint; Polyamide Epoxy Block Filler, 101-11.
c. ICI Paints; Devoe Coatings, Devran 224HS, 224HS.
d. Miller Paint; PPG Aquapon, Polyamide Epoxy Block Filler, 97-685 Series.
e. PPG Architectural Finishes, Inc.; Aquapon, Epoxy Block Filler, 97-685.
f. Sherwin-Williams Company (The); Industrial & Marine, Kem Cati-Coat HS Epoxy Filler/Sealer, B24W400/V400 S.
g. Spectra-Tone; Insl-x, Epoxy Block Filler, EXP 120.

3. VOC Content: Minimum E Range of E1.

2.3 INTERIOR PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

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. Benjamin Moore & Co.; Moorespec, Int. Acrylic Latex Primer/Sealer, 586-00 [Regal, First Coat Latex Primer/Undercoater, 216] [Moorcraft, Latex Undercoater & Primer Sealer, 253-00.
b. Columbia Paint & Coatings; Premium Pro, Interior Latex Enamel Undercoater, 02-735-PP.
c. Coronado Paint; Super Kote 5000, Latex Primer-Sealer, 40-11.
d. ICI Paints; Prep-N-Prime, PVA Interior Primer Sealer, 1030; Prep-N-Prime, Interior Latex Wall Primer, 1000; Devoe/Fuller, Wonder-Tones, DR50801
e. Moore Paints; [cry-Prime, Interior Latex Primer Sealer, 971 Enviro-Cote, Interior Latex Primer, 1505.
f. Porter Paints; Interior Latex Sealer, 37725.
g. PPG Architectural Finishes, Inc.; Speedhide, Int. Latex Primer Sealer, 6-2.

h. Sherwin-Williams Company (The); Spectra-Tone; Jobmaster, PVA Latex Primer Sealer, 74.
i. Vista Paint; Seal Cote, 155.

3. Environmental Characteristics:

a. VOC Content:

1) Minimum E Range of E2.
2) Meets or exceeds LEED requirements for VOC content.

b. Environmental Performance Rating (EPR): Minimum EPR [2] [3].

2.4 METAL PRIMERS

A. Waterborne Galvanized-Metal Primer: MPI #134.

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. Benjamin Moore & Co.; Acrylic Metal Primer, M04.
b. Columbia Paint & Coatings; High-Performance, Waterborne Acrylic Bonding Primer, 05-174-PP.
c. Coronado Paint; H. P. Acrylic Rust Inhibiting Primer, 180-11/147.
d. Duron Inc.; Dura Clad, Acrylic Galvanized Metal Primer, 33-100.
e. ICI Paints; Devoe Coatings, Devflex WB•DTM Primer Finish, 4020.
f. Kelly-Moore Paints; Kel-Guard, Galvanized Iron Primer, 1722.
g. M.A.B. Paints; HydroPrime, 073-189.
h. Porter Paints; Porter Guard, DTM Acrylic Primer/Finish, 215.
i. PPG Architectural Finishes, Inc.; Pitt-Tech, DTM High Performance Primer/Finish, 90-712.
j. Rodda Paint Co.; Professional Maintenance, Metal Master Primer, 508901X.
k. Sherwin-Williams Company (The); Industrial & Marine, DTM Acrylic Primer/Finish, B66W1.
l. Spectra-Tone; Sigmetal Primer ZP, 7143.

3. Environmental Characteristics:

a. VOC Content:

1) Minimum E Range of E1.
2) Meets or exceeds LEED requirements for VOC content.

b. Environmental Performance Rating (EPR): Minimum EPR 1.

2.5 WATER-BASED, LIGHT-INDUSTRIAL COATINGS

A. Semigloss, Water-Based, Light-Industrial Coating: MPI #110-G5.

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. Benjamin Moore & Co.; Latex, M28-08.
    b. Columbia Paint & Coatings; High Performance, Acry-Shield Semi-Gloss Enamel, 05-262.
    c. Coronado Paint; DTM Acrylic Coatings, 182 Line.
    d. ICI Paints; Devoe/Fuller, Mirrolac-WB, DP 84-XX; Devoe Coatings, Devflex WB Acrylic SG Enamel, 4206-0100; Devoe Coatings, Devflex WB Acrylic SG Enamel, 4216.
    e. Sherwin-Williams Company (The); Industrial & Marine, Sher-Cryl HPA Semi-Gloss, B66W351.

3. Environmental Characteristics:

    a. VOC Content:

        1) Minimum E Range of E2.
        2) Meets or exceeds LEED requirements for VOC content.

    b. Environmental Performance Rating (EPR): Minimum EPR 2.

2.6 EPOXY COATINGS

A. Water-Based Epoxy (Interior and Exterior): MPI #115.

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. Benjamin Moore & Co.; Acrylic Epoxy Gloss "A", Hardener "B", M43/M44.
    b. Columbia Paint & Coatings; Dupont, Corlar Waterborne Acrylic Epoxy, 76P.
    c. Coronado Paint; Water-Based Amine Adduct Epoxy, 142 Line.
    d. ICI Paints; Devoe/Fuller, Gardcote-WB, DP25U9XX; Devoe Coatings, Tru Glaze WB Epoxy Gloss Coating, 4408; Devoe Coatings, Tru Glaze WB Epoxy Coating, 4418.
    e. Kelly-Moore Paints; Envira-Poxy, 7100.
    f. Miller Paint; Waterborne Epoxy Gloss, 4300/4440.
    g. Porter Paints; Dura-Glaze WB, Gloss Epoxy, 9371.
    h. PPG Architectural Finishes, Inc.; Aquapon, Waterborne Epoxy, 98-1/98-98.
    i. Sherwin-Williams Company (The); Industrial & Marine, Water Based Catalyzed Epoxy, B70W Series.
    j. Spectra-Tone; Insl-x Aqua-Tile W.B. Epoxy, ATA 100 Series.

3. VOC Content: Minimum E Range of E1.

    a. VOC Content:

        1) Minimum E Range of E1.
        2) Meets or exceeds LEED requirements for VOC content.

b. Environmental Performance Rating (EPR): Minimum EPR 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Concrete: 12 percent.
b. Masonry (Clay and CMU): 12 percent.
c. Wood: 15 percent.
d. Gypsum Board: 12 percent.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
4. Coating application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.

C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi (10 350 to 27 580 kPa) at 6 to 12 inches.
2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."

E. CMU Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust and loose mill scale.

1. Clean using methods recommended in writing by coating manufacturer.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:

1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with specified requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:

1. Water-Based, Light-Industrial Coating System:

a. Prime Coat: Inorganic zinc primer, MPI #19.
b. Intermediate Coat: Water-based, light-industrial coating, MPI #110, gloss matching topcoat.
c. Topcoat: Water-based, light-industrial coating, MPI #110-G5, semigloss.

B. Galvanized-Metal Substrates:

1. Water-Based, Light-Industrial Coating System:

a. Prime Coat: Waterborne galvanized-metal primer, MPI #134.
b. Intermediate Coat: Water-based, light-industrial coating, MPI #110, gloss matching topcoat.
c. Topcoat: Water-based, light-industrial coating, MPI #110-G5, semigloss.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. CMU Substrates:

1. Water-Based Epoxy Coating System:

a. Prime Coat: Interior/exterior latex block filler, MPI #4.
b. Intermediate Coat: Water-based epoxy (interior and exterior), MPI #115.
c. Topcoat: Water-based epoxy (interior and exterior), MPI #115.

B. Steel Substrates:

1. Water-Based, Light-Industrial Coating System:

a. Prime Coat: Rust-inhibitive primer (water based), MPI #107.

b. Intermediate Coat: Water-based, light-industrial coating, MPI #110, gloss matching topcoat.
c. Topcoat: Water-based, light-industrial coating, MPI #110-G5, semigloss.

C. Galvanized-Metal Substrates:

1. Water-Based, Light-Industrial Coating System:

a. Prime Coat: Waterborne galvanized-metal primer, MPI #134.
b. Intermediate Coat: Water-based, light-industrial coating, MPI #110, gloss matching topcoat.
c. Topcoat: Water-based, light-industrial coating, MPI #110-G5, semigloss.

D. Gypsum Board Substrates:

1. Water-Based Epoxy Coating System:

a. Prime Coat: Interior latex primer/sealer, MPI #50.
b. Intermediate Coat: Water-based epoxy (interior and exterior), MPI #115.
c. Topcoat: Water-based epoxy (interior and exterior), MPI #115.

END OF SECTION 09960

SECTION 10155 - TOILET 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 toilet compartments and screens as follows:

1. Type: Phenolic core units as follows.
2. Compartment Style: Ceiling hung.
3. Urinal Screens: Wall hung.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for applicable Owners SPiRiT requirements.
2. Division 5 Section "Metal Fabrications" for supports that attach ceiling-hung units to overhead structural system.
3. Division 10 "Toilet and Bath Accessories" for toilet paper holders, grab bars, and similar accessories.

1.3 SUBMITTALS

A. Product Data: For each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware, and fastenings.

B. Shop Drawings: For fabrication and installation of toilet compartment and screen assemblies. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of reinforcement and cutouts for compartment-mounted toilet accessories.

C. 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 or screen indicated.

D. Samples for Verification: Of each compartment or screen color and finish required, prepared on 6-inch-(150-mm-) square Samples of same thickness and material indicated for Work.

E. SPiRiT Submittals: SPiRiT Credit: MR 4.C4 for recycled material content.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions in areas of installation 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 units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PHENOLIC-CORE UNITS

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. Accurate Partitions Corporation.
2. American Sanitary Partition Corporation.
3. Ampco.
4. Bobrick Washroom Equipment, Inc.
5. Bradley Corporation; Mills Partitions.
6. Capitol Partitions, Inc.
7. General Partitions Mfg. Corp.
8. Metpar Corp.
9. Partition Systems, Inc.
10. Sanymetal; a Crane Plumbing Company.

B. Door, Panel and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.

1. Facing Sheet Color: One color in each room as selected by Architect from manufacturer's full range of colors.
2. Core Color: Manufacturer's standard dark color.

C. Pilaster Sleeves (Caps): Stainless steel, ASTM A 666, Type 302 or 304, not less than 0.0312 inch (0.8 mm) specified thickness and 3 inches (75 mm) high, finished to match hardware.

D. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, stainless steel.
2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel .

2.2 MATERIALS

A. General: Provide materials that have been selected for surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are unacceptable.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.4 FABRICATION

A. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

B. Doors: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments indicated to be accessible to people with disabilities.

1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
2. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, plumb, and level. Provide clearances of not more than 1/2 inch(13 mm) between pilasters and panels and not more than 1 inch(25 mm) between panels and walls. Secure units in position with manufacturer's recommended anchoring devices.

1. Secure panels to walls and panels with not less than 2 stirrup brackets attached near top and bottom of panel. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

C. Wall-Hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING AND CLEANING

A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.

B. Provide final protection and maintain conditions that ensure toilet compartments and screens are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10155

SECTION 10264 – SPECIAL WALL FINISHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Fiber-reinforced plastic sheet and panel wall coverings.

B. Related Sections include the following:

1. Division 9 Section "Gypsum Board Assemblies" for gypsum board substrate.

1.3 SUBMITTALS

A. Product Data: Include physical characteristics, such as durability, resistance to fading, and flame resistance, for each impact-resistant wall protection system component indicated.

B. 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. Sheet or Panels: 6-by-6-inch-(150-by-150-mm-) square Samples of each impact-resistant wall protection system component required.

2. Corner Guards: 12 inches (300 mm) long. Include examples of joinery, corners, end caps, top caps, and field splices.

C. Material Test Reports: From a qualified testing agency indicating compliance of each impact-resistant wall protection system component with requirements indicated, based on tests performed by testing agency within the past five years.

D. Maintenance Data: For each impact-resistant wall protection system component to include in maintenance manuals specified in Division 1.

1. Include recommended methods and frequency for maintaining optimum condition of vinyl plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to vinyl plastic finishes and performance.

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 indi-

cated 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 each color, grade, finish, and type of 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: 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, or in-service performance.

E. Fire-Test-Response Characteristics: Provide impact-resistant wall protection system components with the following surface-burning characteristics, as determined by testing materials identical to those required in this Section per ASTM E 84 by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify impact-resistant wall protection system components with appropriate markings of applicable testing and inspecting agency.

1. Flame Spread: 25 or less.
2. Smoke Developed: 450 or less.

F. 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.
2. Store rigid plastic corner-guard covers in a vertical position, and rigid plastic wall guard and handrail covers in a horizontal position for a minimum of 72 hours, or until the plastic material attains the minimum room temperature of 70 deg F(21 deg C).

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install wall surface-protection system components until the space is enclosed and weatherproof and ambient temperature within the building is maintained at not less than 70 deg F(21 deg C) for not less than 72 hours before beginning installation. Do not install rigid plastic wall surface-protection systems until that temperature has been attained and is stabilized.

1.7 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. Impact-Resistant Wall Protection System Units: Full-size units of maximum length, including vinyl plastic cover and aluminum retainer, equal to 2 percent of each type, color, and texture of each type of unit installed, but not less than two units.

a. Include accessory components as required. Replacement materials shall be from the same production run as materials installed. Package replacement materials with protective covering, identified with appropriate labels.

PART 2 - PRODUCTS

2.1 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.
13. Approved equal.

2.2 MATERIALS

A. Plastic Sheet Wall Covering Material: Semirigid, textured, chemical- and stain-resistant, high-impact-resistant, PVC or acrylic-modified vinyl plastic sheet; 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. Extruded Rigid Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; thickness as indicated.

1. Impact Resistance: Minimum 25.4 ft-lbf/in. (1356 J/m) of notch when tested according to ASTM D 256, Test Method A.

2. Chemical and Stain Resistance: Tested according to ASTM D 543.
3. Self-extinguishing when tested according to ASTM D 635.
4. Flame-Spread Index: 25 or less.
5. Smoke-Developed Index: 450 or less.

C. Fasteners: Provide aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with aluminum components, hardware, anchors, and other items being fastened. Use theftproof fasteners where exposed to view.

D. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.

1. Use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Gypsum Board and Panel Adhesives: 50 g/L.
b. Multipurpose Construction Adhesives: 70 g/L.
c. Contact Adhesive: 250 g/L.

2.3 FABRICATION

A. General: Fabricate impact-resistant wall and corner protection systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including thicknesses of components.

B. Preassemble components in the shop to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Fabricate components with tight seams and joints 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.

D. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors for interconnecting members to other construction.

E. Provide inserts and other anchoring devices for connecting components to concrete or masonry. Fabricate anchoring devices to withstand imposed loads. Coordinate anchoring devices with the supporting structure.

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 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 and impact-resistant wall covering materials will be installed.

1. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Impact-Resistant Wall Covering Materials: Wall surfaces to receive impact-resistant wall covering materials shall be dry and free from dirt, grease, loose paint, and scale.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.

B. General: Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

3.4 CLEANING

A. General: Immediately on completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent. Clean metal components according to the manufacturer's written instructions.

B. Remove excess adhesive using methods and materials recommended by the manufacturer.

C. Remove surplus materials, rubbish, and debris, resulting from installation, on completion of work and leave installation areas in neat, clean condition.

END OF SECTION 10264

SECTION 10426 - PANEL SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Division 1 Specification Sections, the General and Supplemental Conditions, and Project Drawings apply to this section.

1.2 SUMMARY OF WORK

A. This section includes the following types of panel signs:

1. ADA compliant, laminated panel signs.
2. Interior Room Identification laminated panel signs.

1.3 SUBMITTALS

Product data for each material relative to tactile copy, face laminate, backing sheets, adhesives.

A. Shop drawings showing fabrication and erection of signs. Include large scale plans, elevations, and sections showing construction and layout of typical components.

Provide message list for each sign required, including large scale details of lettering and Braille layout.

B. Samples: Provide the following samples of each sign component for initial selection of color, pattern, surface texture and demonstration of compliance with product requirements.

Tactile appliqué laminate: Manufacturer's color charts consisting of actual sections of material demonstrating the full range of colors available.
Face laminate: 4"x 4" sections of clear material demonstrating non glare surface.

C. Samples for Initial Selection: For each type of sign material indicated that involves color selection.

D. Samples for Verification: For each type of sign, include the following Samples to verify color selected:

1. Panel Signs: Full-size Samples of each type of sign required.
2. Dimensional Characters: Full-size Samples of each type of dimensional character (letter and number) required. Show character style, material, finish, and method of attachment.
3. Casting: Show representative texture, character style, spacing, finish, and method of attachment.
4. Revise subparagraph below to suit Project.
5. Approved samples will not be returned for installation into Project.

6. Coordinate paragraph below with qualification requirements in Division 1 Section "Quality Requirements" and as supplemented in "Quality Assurance" Article.
7. Qualification Data: For Installer.
8. Revise below to suit Project.
9. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by signage manufacturer.

B. Source Limitations: Obtain each sign type through one source from a single manufacturer.

C. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

1. Interior Code Signage: Provide signage as required by accessibility regulations and requirements of authorities having jurisdiction. These include, but are not limited to, the following:

a. Illuminated Exit Signs: Refer to Division 16.
b. Fire Doors: Refer to Door Schedule.
c. Room Capacity: Where required for Assembly rooms.
d. Elevator Signs: ADA.
e. Stairway Identification: ADA.
f. Signs for Accessible Spaces: ADA.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

Manufacturers: Subject to compliance with the requirements, provide products from one of the following:

A. Manufactures of panel signs:
ABC Architectural Sign Systems
ASI Sign Systems, Inc.
Best Manufacturing
Environmental Graphic Systems, Inc.
Modulex.
The Super Sign Company.
Approved equal.

MATERIALS

Tactile appliqué: Opaque, single ply, modified acrylic sheet not less than 1/32" in thick- ness.
Face laminate: Clear, non glare, cast acrylic sheet or matte finish impact acrylic engraving stock not less than 1/16" in thickness.
Backing sheet: Expanded PVC sign board not less than 1/8" (3mm) in thickness.

'Sintra' manufactured by Alusuisse Composites, Inc., and 'Versacel' manufactured by HPG International, Inc., are acceptable products. Product of other manufactures exhibiting equal physical properties may be substituted. Provide color directed by the Architect.

LAMINATED PANEL SIGNS

Comply with requirement indicated for materials, thickness, finish, color, design, shape, size, and detail of construction.

Tactile text shall be .75 inch in height and shall be located at the top left side of the sign. A margin of .75 inch shall be maintained between copy and the sign edges. Characters shall be machine cut to provide uniform smooth beveled edges and shall be permanently bonded to the face material using specially formulated adhesive or chemical welding. Graphic content shall comply with ADA requirements for size, style, spacing, content, position, material, finish, and color contrast
ADA Grade 2 Braille shall be provided on each sign, and shall be located .375 inch below and left justified with tactile text. Braille shall be the applied Raster method.
Size. Non insert signs shall be 10" wide and 7" high, or as indicated on drawings.
Face laminations shall be 1/16", single ply, clear cast acrylic, or impact acrylic with a matte or non glare finish. Each face lamination shall be back sprayed with an opaque colored coating compatible with the material. Color shall be as selected by the Architect. Application to spacer and backer sheets shall utilize 100% adhesive coverage within each lamination.
Cutouts shall be provided in face laminations on "insert" style signs. Cutouts shall be 1.75" high x 9" wide and shall be centered accurately over each insert slot. Vertical spacing between cutouts on multiple insert signs shall be .75".
Edges condition. Square cut. Provide edge finishing after fabrication producing a smooth even surface across the laminations.
Corner condition. Provide .5" radius corners produced after lamination.

2.2.1 Accessible Parking Signs:

2. Material: 0.080-inch (2-mm) aluminum or other noncorrosive material.
3. Background Color: Blue.
4. Copy Material: White silk-screen.
5. Mounting: Flush mounted to building with fasteners to suit building substrate, where indicated.
6. Post mounted as indicated.

D. Symbols of Accessibility: Provide 6-inch- (150-mm-) high symbol fabricated from opaque nonreflective vinyl film, 0.0035-inch (0.089-mm) nominal thickness, with pressure-sensitive adhesive backing suitable for both exterior and interior applications.

PART 3 – EXECUTION

INSTALLATION

A. Install sign units as indicated or directed by the Architect. Use methods of the type described and in accordance with the manufacturer's instructions.

B. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

Wall mounted signs.
Attach to non porous surfaces or sealed masonry using double sided foam tape equal to 3M 'VHB' High Performance Series.
Use silicone adhesive recommended by the sign manufacturer for installation on irregular surfaces, unsealed masonry, or vinyl covered surfaces. Use double sided tape to hold signs in place until adhesive is fully cured.

CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect from damage until acceptance by the Owner.

END OF SECTION 10426

SECTION 10505 - METAL LOCKERS

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. All-welded athletic metal lockers, as indicated.
2. All-welded equipment metal lockers, as indicated.
3. Locker benches.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for applicable Owner's SPIRIT requirements.
2. Division 6 Section "Miscellaneous Carpentry" for furring, blocking, and shims required for installing metal lockers and concealed within other construction before metal locker installation.

1.3 DEFINITIONS

A. Uncoated Steel Sheet Thicknesses: Indicated as the minimum thicknesses.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, recycled material content and low VOC finishes for each type of metal locker and bench.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Show base, sloping tops, filler panels, recess trim and other accessories.
2. Include locker identification system.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For metal lockers and locker benches, in manufacturer's standard sizes.

E. Qualification Data: For Installer.

F. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of metal locker manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Obtain metal lockers and accessories through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal lockers 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. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG).", ICC A117.1., FED-STD-795, "Uniform Federal Accessibility Standards." State of Utah Code Adoptions and Amendments.

1. Provide not less than 1 shelf located no higher than 48 inches (1219 mm) above the floor for forward or 54 inches (1372 mm) above the floor for side reach.
2. Provide 1 shelf located at bottom of locker no lower than 15 inches (381 mm) above the floor for forward or 9 inches (230 mm) above the floor for side reach.
3. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf (22.2 N).

E. 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. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for metal locker installation.

B. Deliver master and control keys to Owner by registered mail or overnight package service, addressed as follows:

1. Utah National Guard, 144th Medical Company Readiness Center, Camp W.G. Williams, Riverton, Utah 84065-4999.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurements on Shop Drawings:

1. Concealed framing, blocking, and reinforcements that support metal lockers before they are enclosed.
2. Recessed openings.
3. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish recessed opening dimensions and proceed with fabricating metal lockers without field measurements. Coordinate wall and floor construction to ensure that actual recessed opening 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 metal lockers can be supported and installed as indicated.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for All-Welded Metal Lockers: 10 years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below, before construction begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than 5 units:

a. Locks.
b. Identification plates.
c. Hooks.

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. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS) Type B, suitable for exposed applications.

B. Stainless-Steel Sheet: ASTM A 666, Type 304.

C. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.

D. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.

E. Anchors: Select material, type, size, and finish required for secure anchorage to each substrate.

   1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.
   2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.3 ALL-WELDED, ATHLETIC AND EQUIPMENT METAL LOCKERS

A. Available Products:

   1. All-Welded, Athletic and Equipment Metal Lockers:

      a. Art Metal Products, Div. of Fort Knox Storage Co.; 1001 Lockers.
      b. DeBourgh Mfg. Co.; Physical Education Lockers.
      c. List Industries Inc.; Gym Class Lockers.
      d. Lyon Workspace Products; Lockers.
      e. Penco Products, Inc., Subsidiary of Vesper Corporation; All-Welded Lockers.
      f. Republic Storage Systems Company; All-Welded Ventilated Lockers.
      g. Approved equal.

B. Locker Arrangement: Double tier athletic and single tier equipment lockers.

C. Body: Assembled by welding body components together. Fabricate from unperforated, cold-rolled steel sheet with thicknesses as follows:

   1. Tops and Bottoms: 0.0528 inch (1.35 mm) thick, with single bend at edges.
   2. Backs: 0.0428 inch (1.1 mm) thick.

3. Shelves: 0.0528 inch (1.35 mm) thick, with double bend at front and right-angle single bend at sides and back.

D. Unperforated Sides: Fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet.

E. Frames: Channel formed; fabricated from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet or 0.0966-inch- (2.5-mm-) thick steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.

1. Cross Frames for Double-Tier Lockers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.

F. Locker Base: Structural channels, formed from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet; welded to front and rear of side-panel frames.

G. Perforated Doors: One-piece, fabricated from 0.0677-inch- (1.7-mm-) thick, cold-rolled steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges and latch point bottom) and right-angle single bend at remaining edges for box lockers.

1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.

H. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Continuous Hinges: Manufacturer's standard, steel continuous hinge; side or top mounted as required by locker configuration.

I. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in , built-in cylinder locks, or padlocks; positive automatic and prelocking.

a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with 3 latch hooks and doors less than 48 inches (1219 mm) high with 2 latch hooks; fabricated from minimum 0.1116-inch- (2.8-mm-) thick steel; welded to full-height door strikes; with resilient silencer on each latch hook.
b. Latching Mechanism: Manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

J. Door Handle and Latch for Box Lockers: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.

K. Cylinder Locks: Built-in, flush, cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and five master keys.

1. Key Type: Grooved.
2. Bolt Operation: Manually locking deadbolt.

L. Equipment: Equip each metal locker with identification plate and the following, unless otherwise indicated:

1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
3. Coat Rods: As indicated on Drawings.

M. Accessories:

1. Continuous Base: 4 inches (102 mm) high; fabricated from 0.0677-inch- (1.7-mm-) thick, cold-rolled steel sheet.
2. Continuous Sloping Tops: Fabricated from minimum 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet; approximately 20-degree pitch.

    a. Closures: Vertical-end type.

3. Recess Trim: Fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet.
4. Filler Panels: Fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet.
5. Boxed End Panels: Fabricated from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet.

N. Finish: Baked enamel.

1. Color(s): As selected by Architect from manufacturer's full range.

2.4 LOCKER BENCHES

A. General: Provide locker benches fabricated by same manufacturer as metal lockers.

B. Bench Tops: Manufacturer's standard 1-piece units, of the following material, minimum 11-1/2 inches (290 mm) wide by 1-1/4 inches (32 mm) thick, with rounded corners and edges:

1. Laminated maple with one coat of clear sealer on all surfaces, and one coat of clear lacquer on top and sides.

C. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

1. Cast Iron: 1-1/2-inch- (38-mm-) diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.

    a. Color: Match metal lockers selected by Architect from manufacturer's full range.

2.5 FABRICATION

A. General: Fabricate metal lockers square, rigid, and without warp; with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet, unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for a complete installation.

B. Unit Principle: Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections, with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.

D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

E. Identification Plates: Manufacturer's standard etched, embossed, or stamped aluminum plates; with numbers and letters at least 3/8 inch (9 mm) high.

F. Continuous Base: Formed into channel or Z profile for stiffness, and fabricated in lengths as long as practicable to enclose base and base ends of metal lockers; finished to match lockers.

G. Continuous Sloping Tops: Fabricated in lengths as long as practicable, without visible fasteners at splice locations; finished to match lockers.

1. Sloped top corner fillers, mitered.

H. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practicable; finished to match lockers.

I. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip joint filler angle formed to receive filler panel.

J. Boxed End Panels: Fabricated with 1-inch- (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

K. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

L. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

2.6 STEEL SHEET FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

C. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.

D. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.
2. Anchor single rows of metal lockers to walls near top and bottom of lockers and to floor.
3. Anchor back-to-back metal lockers to floor.

B. All-Welded Metal Lockers: Connect groups of all-welded metal lockers together with standard fasteners, with no exposed fasteners on face frames.

C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach hooks with at least two fasteners.
2. Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers with identification indicated on Drawings.

a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.

b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

4. Attach recess trim to recessed metal lockers with concealed clips.
5. Attach filler panels with concealed fasteners. Locate fillers panels where indicated on Drawings.
6. Attach sloping top units to metal lockers, with closures at exposed ends.
7. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
8. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

D. Fixed Locker Benches: Provide not less than 2 pedestals for each bench, uniformly spaced not more than 72 inches (1830 mm) apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

E. Freestanding Locker Benches: Place benches in locations indicated on Drawings.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit metal locker use during construction.

C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal locker manufacturer.

END OF SECTION 10505

SECTION 10520 - 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 the following:

    a. Portable fire extinguishers.

3. Mounting brackets for fire extinguishers.

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 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. Ansul Incorporated.
   c. Badger; Div. of Figgie Fire Protection Systems.
   d. Buckeye Fire Equipment Company.
   e. f. General Fire Extinguisher Corporation.
   g. J.L. Industries, Inc.
   h. Kidde: Walter Kidde, The Fire Extinguisher Co.
   i. Larsen's Manufacturing Company.
   j. Modern Metal Products; Div. of Technico.
   k. Moon/American, Inc.
   l. Pem All; Div. of Pem Systems, Inc.
   m. Potter-Roemer; Div. of Smith Industries, Inc.
   n. Samson Products, Inc.
   o. Watrous; Div. of American Specialties, Inc.

2. Fire-Protection Cabinets:
   a. Filtrine Manufacturing Company.
   b. Fire-End & Croker Corporation.
   c. General Accessory Manufacturing Co.
   d. J.L. Industries, Inc.
   e. Larsen's Manufacturing Company.
   f. Modern Metal Products; Div. of Technico.
   g. Moon/American, Inc.
   h. Potter-Roemer; Div. of Smith Industries, Inc.
   i. Samson Products, Inc.
   j. Thomas Enterprises.
   k. Watrous; Div. of American Specialties, Inc.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A 366/A 366M, commercial quality, stretcher leveled, temper rolled.

2.3 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.

B. Dry-Chemical Type: UL-rated 10-B:C, 5-lb (2.3-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. Fire-Rated Cabinets: Listed and labeled to meet requirements of ASTM E 814 for fire-resistance rating of wall where it is installed.

a. Construct fire-rated cabinets with double walls fabricated from 0.0478-inch- (1.2-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material.
b. Provide factory-drilled mounting holes.

2. Cabinet Metal: Enameled-steel sheet.

B. Cabinet Type: Suitable for the following:

1. Fire extinguisher.

C. Cabinet Mounting: Suitable for the following mounting conditions:

1. Surface Mounted: Cabinet box fully exposed and mounted directly on wall.

D. Cabinet Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

1. Trimless: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet.

a. Provide recessed flange, of same material as box, attached to box to act as plaster stop.

E. Cabinet Trim Material: Manufacturer's standard, as follows:

1. Steel sheet.

F. Door Material: Manufacturer's standard, as follows:

1. Steel sheet.

G. Door Glazing: Manufacturer's standard, as follows:

1. Break 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. Fully glazed panel with frame.

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 for break-glass panels.

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. Break-Glass Strike: Provide manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.

B. Lettered Door Handle: Provide one-piece, cast-iron door handle with the word "FIRE" embossed into face.

C. Door Locks: Provide cylinder lock, with all cabinets keyed alike.

D. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.

2.6 COLORS AND TEXTURES

A. Colors and Textures: As selected by Architect from manufacturer's full range for these characteristics.

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. 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 the following:

1. Exterior of cabinets and doors, except for those surfaces indicated to receive another finish.
2. Interior of cabinets and doors.

2.8 STEEL FINISHES

A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.

B. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.

1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer, selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

C. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.9 MOUNTING BRACKETS

A. Available Manufacturers:

1. Amerex Corporation.
2. Ansul Incorporated.
3. Badger Fire Protection.
4. Buckeye Fire Equipment Company.
5. Fire End & Croker Corporation.
6. General Fire Extinguisher Corporation.
7. JL Industries, Inc.
8. Larsen's Manufacturing Company.
9. Potter Roemer; Div. of Smith Industries, Inc.

B. Mounting Brackets: Manufacturer's standard galvanized steel, 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.

1. Color: Black.

C. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose valves, hose racks, and cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed and 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. 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 10520

SECTION 10605 - WIRE MESH PARTITIONS

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 items fabricated from wire mesh:

1. Standard-duty, interior partitions.

B. Related Sections include the following:

1. Division 8 Section "Door Hardware" for lock cylinders and keying for wire mesh partition doors.
2. Division 9 Section "Painting" for field painting wire mesh items.

1.3 DEFINITIONS

A. Terms below shall be as defined in ASTM E 2016:

1. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.
2. Lock Crimp: Deep crimps at points of intersection that lock wires securely in place.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide exterior wire mesh partitions 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 5 MPH, acting inward or outward.
b. Uniform pressure as indicated on Drawings.

B. Structural Performance of Wire Mesh Railing Insert Panels: Comply with requirements of ASTM E 985 for structural performance, based on testing performed according to ASTM E 935.

C. Structural Performance of Wire Mesh Railing Insert Panels: Capable of withstanding structural loads required by ASCE 7 without exceeding allowable design working stresses of materials for railings, anchors, and connections.

D. Structural Performance of Wire Mesh Railing Insert Panels: Capable of withstanding a horizontally applied normal load of 50 lbf (0.22 kN) on an area not to exceed 1 sq. ft. (0.09 sq. m) at any point without exceeding allowable design working stresses of materials for railings, anchors, and connections.

E. Seismic Performance: Provide wire mesh partitions capable of withstanding the effects of earthquake motions determined according to Section 9, "Earthquake Loads."

F. Thermal Movements: Provide exterior wire mesh items that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening 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.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wire mesh items.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: 12-by-12-inch (300-by-300-mm) panel constructed of specified frame members and wire mesh. Show method of finishing members at intersections.

E. Qualification Data: For Installer.

F. Maintenance Data: For wire mesh partition door hardware to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1. Installer's responsibilities include fabricating and installing wire mesh items and providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of data for wire mesh items, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Source Limitations: Obtain wire mesh items through one source from a single manufacturer.

C. 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."

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire mesh items with cardboard protectors on perimeters of panels and doors and with posts wrapped to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Inventory wire mesh partition door hardware on receipt and provide secure lockup for wire mesh partition door hardware delivered to Project site.

1. Tag each item or package separately with identification and include basic installation instructions with each item or package.

2. Deliver keys to Owner by registered mail or overnight package service

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of construction contiguous with wire mesh items 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 location dimensions and proceed with fabricating wire mesh items without field measurements. Coordinate wall, column, floor, and ceiling construction to ensure that actual location dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate installation of anchorages for wire mesh items supported or anchored to permanent construction. 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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acorn Wire & Iron Works, Inc.
2. California Wire Products Corporation.
3. G-S Company (The).
4. Indiana Wire Products, Inc.
5. Jesco Industries, Inc.
6. King Wire Partitions, Inc.
7. Miller Wire Works, Inc.
8. Newark Wire Works Inc.
9. SpaceGuard Products.
10. Standard Wire & Steel Works.
11. Wire Crafters, Inc.

2.2 MATERIALS

A. Steel Wire: ASTM A 510 (ASTM A 510M).

B. Steel Plates, Channels, Angles, and Bars: ASTM A 36/A 36M.

C. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

D. Steel Pipe: ASTM A 53/A 53M, Schedule 40, unless another weight is indicated or required by structural loads.

E. Square Steel Tubing: Cold-formed structural-steel tubing, ASTM A 500.

F. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.

G. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts.

H. Postinstalled Expansion Anchors in Concrete: 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 (0.005 mm) for Class SC 1 service condition (mild).
2. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Alloy Group 1 or 4) for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.
3. For Postinstalled Anchors in Concrete: Capability to sustain, without failure, a load equal to four times the loads imposed.
4. For Postinstalled Anchors in Grouted Masonry Units: Capability to sustain, without failure, a load equal to six times the loads imposed.

I. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated and 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 wire mesh construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

J. Seismic Bracing: Angles with legs not less than 1-1/4 inch (32 mm) wide, formed from 0.04-inch- (1-mm-) thick, metallic-coated steel sheet; with bolted connections and 1/4-inch- (6-mm-) diameter bolts.

2.3 PAINT

A. Shop Primers: Provide primers to comply with applicable requirements in Division 9 painting Sections.

B. 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.

C. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.

2.4 STANDARD-DUTY WIRE MESH PARTITIONS

A. Mesh: 0.135-inch- (3.5-mm-) diameter, intermediate-crimp steel wire woven into 1-1/2-inch (38-mm) diamond mesh.

B. Vertical Panel Framing: 1-1/4-by-5/8-by-0.0966-inch (32-by-16-by-2.5-mm) cold-rolled, C-shaped steel channels with 1/4-inch- (6-mm-) diameter bolt holes spaced not more than 18 inches (450 mm) o.c. along center of framing.

C. Horizontal Panel Framing: 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) cold-rolled steel channels.

D. Horizontal Panel Stiffeners: 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) cold-rolled steel channels with wire woven through, or two 1-by-3/8-by-1/8-inch (25-by-9.5-by-3-mm) cold-rolled steel channels bolted or riveted toe to toe through mesh.

E. Top Capping Bars: 2-1/4-by-1-inch (57-by-25-mm) cold-rolled steel channels.

F. Posts for 90-Degree Corners: 1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3-mm) steel angles with 1/4-inch- (6-mm-) diameter bolt holes aligning with bolt holes in vertical framing; with floor anchor clips.

G. Posts for Other-Than-90-Degree Corners: Manufacturer's standard steel pipe or tubing with 1/4-inch- (6-mm-) diameter bolt holes aligning with bolt holes in vertical framing.

1. Partitions Up to 12 Feet (3.7 m) High: 1-1/4-inch (32 mm) OD.
2. Partitions Up to 20 Feet (6.1 m) High: 2-1/2-inch (65 mm) OD.

H. Adjustable Corner Posts: Two, manufacturer's standard steel pipe or tubing posts connected by steel hinges at 36 inches (900 mm) o.c. attached to posts; with 1/4-inch- (6-mm-) diameter bolt holes aligning with bolt holes in vertical framing.

I. Line Posts: 3-inch-by-4.1-lb (76-mm-by-1.9-kg) or 3-1/2-by-1-1/4-by-0.1265-inch (89-by-32-by-3.2-mm) steel channels; with 5-by-18-by-1/4-inch (125-by-450-by-6-mm) steel base plates punched for attachment to floor.

J. Three and Four-Way Intersection Posts: 1-1/4-by-1-1/4-inch (32-by-32-mm) tubular steel, with 1/4-inch- (6-mm-) diameter bolt holes aligned for bolting to adjacent panels.

K. Floor Shoes: Steel, cast iron, or cast aluminum, 2 inches (50 mm) high; sized to suit vertical framing, drilled for attachment to floor, and with set screws for leveling adjustment.

L. Swinging Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3-mm) steel channels or C-channels, banded with 1-1/4-by-1/8-inch (32-by-3-mm) flat steel bar cover plates on 3 sides, and with 1/8-inch- (3-mm-) thick angle strike bar and cover on strike jamb.

1. Hinges: Full-surface type, 3-by-3-inch (76-by-76-mm) steel, 1-1/2 pairs per door; bolted, riveted, or welded to door and jamb framing.
2. Padlock Lug: Mortised into door framing and enclosed with steel cover.
3. Cylinder Lock: Mortise type with manufacturer's standard cylinder operated by key outside and recessed knob inside.
4. Inactive Leaf Hardware: Cane bolt at bottom and chain bolt at top.

M. Accessories:

1. Sheet Metal Base: 0.0598-inch- (1.5-mm-) thick, cold-rolled steel sheet.
2. Adjustable Filler Panels: 0.0598-inch- (1.5-mm-) thick, cold-rolled steel sheet; capable of filling openings from 2 to 12 inches (50 to 300 mm).
3. Wall Clips: Manufacturer's standard, cold-rolled steel sheet; allowing up to 1 inch (25 mm) of adjustment.

N. Finishes for Interior Locations: Shop primed for field painting.

1. Color: As selected by Architect from manufacturer's full range.

2.5 FABRICATION

A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-size components as recommended by wire mesh item manufacturer. Provide bolts, hardware, and accessories as required for complete installation.

1. Fabricate wire mesh items to be readily disassembled.
2. Welding: Weld corner joints of framing and remove spatter.

B. Standard-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.

1. Mesh: Securely clinch mesh to framing.
2. Framing: Fabricate framing with mortise and tenon corner construction.

a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.
b. Fabricate three- and four-way intersections manufacturer's standard connecting clips and fasteners.
c. Fabricate partition and door framing with slotted holes for connecting adjacent panels.

3. Fabricate wire mesh partitions with 3 inches (76 mm) of clear space between finished floor and bottom horizontal framing.
4. Fabricate wire mesh partitions with bottom horizontal framing flush with finished floor.
5. Doors: Align bottom of door with bottom of adjacent panels.

a. For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.

6. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

2.6 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish wire mesh items after assembly.
2. 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.

B. Preparation for Shop Priming Nongalvanized Surfaces: Prepare nongalvanized surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed wire mesh items:

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. Shop Priming: Apply shop primer to uncoated surfaces of wire mesh items, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

1. Do not apply primer to galvanized surfaces.
2. Stripe paint corners, crevices, bolts, welds, and sharp edges.

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.

B. Examine floors for suitable conditions where wire mesh items will be installed.

C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Wire Mesh Partitions:

1. Anchor wire mesh partitions to floor with 3/8-inch- (9.5-mm-) diameter, postinstalled expansion anchors at 12 inches (305 mm) o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.
2. Anchor wire mesh partitions to floor with 3/8-inch- (9.5-mm-) diameter, postinstalled expansion anchors at 12 inches (305 mm) o.c. through floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.

    a. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated on Shop Drawings.

3. Anchor wire mesh partitions to walls at 12 inches (305 mm) o.c. through back corner panel framing and as follows:

    a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
    b. For hollow masonry anchorage, use toggle bolts.
    c. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
    d. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
    e. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

4. Secure top capping bars to top framing channels with 1/4-inch- (6-mm-) diameter "U" bolts spaced not more than 28 inches (700 mm) o.c.
5. Provide line posts at locations indicated or, if not indicated, as follows:

    a. On each side of sliding door openings.
    b. For partitions that are 7 to 9 feet (2.1 to 2.7 m) high, spaced at 15 to 20 feet (4.6 to 6.1 m) o.c.
    c. For partitions that are 10 to 12 feet (3.0 to 3.7 m) high, located between every other panel.
    d. For partitions that are more than 12 feet (3.7 m) high, located between each panel.

6. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.

7. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.
8. Install doors complete with door hardware.
9. Install security windows complete with window hardware.
10. Weld or bolt sheet metal bases to wire mesh partitions and doors where indicated.
11. Bolt accessories to wire mesh partition framing.

3.3 ADJUSTING AND CLEANING

A. Adjust doors to operate easily without binding.

B. Check and readjust operating hardware items just before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work including doors and framing that are warped, bowed, or otherwise unacceptable.

C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint; paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

D. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.

E. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas; repair galvanizing to comply with ASTM A 780.

END OF SECTION 10605

SECTION 10651 - OPERABLE PANEL PARTITIONS

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. Manually operated, paired-panel partitions.

B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for framing and supports for Operable Panel Partitions.
2. 9 Section "Gypsum Board Assemblies" for sound barrier construction above the ceiling at track.
3. Division 9 painting Sections for painted finishes.

1.3 DEFINITIONS

A. NIC: Noise Isolation Class.

B. NRC: Noise Reduction Coefficient.

C. NVLAP: National Voluntary Laboratory Accreditation Program.

D. STC: Sound Transmission Class.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Provide operable panel partitions capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

B. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound Transmission Requirements: Operable panel partition assembly tested in a full-scale opening, 14 by 9 feet (4.2 by 2.7 m), for laboratory sound transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.

1.5 SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.

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.
2. Indicate storage and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.

C. Setting Drawings: For embedded items and cutouts required in other work, including support-beam punching template.

D. Samples for Initial Selection: For each type of finish, covering, or facing indicated.

1. Include similar Samples of accessories involving color selection.

E. Product Certificates: For each type of operable panel partition, signed by product manufacturer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each operable panel partition.

G. Maintenance Data: For operable panel partitions to include in maintenance manuals.

1. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
2. Seals, hardware, track, carriers, and other operating components.
3. For electric operator.

H. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent agency or an NVLAP-accredited laboratory. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation," listing the test methods specified.

C. Fire-Test-Response Characteristics: Provide operable panel partitions 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 Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify operable panel partition openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of operable panel partitions.
b. Deterioration of metals, metal finishes, and other materials beyond normal wear.

2. Warranty Period: Five years from date of Substantial Completion.

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. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Advanced Equipment Corporation.
2. FolDoor, Holcomb & Hoke Mfg. Co., Inc..
3. Hufcor.
4. KWIK-WALL Company.
5. Moderco Inc.
6. Modernfold, Inc.
7. Panelfold Inc.

2.2 MATERIALS

A. Steel Frame: Steel sheet, manufacturer's standard nominal specified thickness for uncoated steel, for panel size scheduled.

B. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B 221 (ASTM B 221M) for extrusions; manufacturer's standard strengths and thicknesses for type of use.

1. Frame Reinforcement: Manufacturer's standard steel or aluminum.

C. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard thickness.

D. Gypsum Board: ASTM C 36/C 36M.

2.3 OPERABLE PANELS

A. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

B. Dimensions: Fabricate operable panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

1. Panel Width: Standard widths.

C. STC: Not less than 50.

D. Panel Weight: 10 lb/sq. ft. (50 kg/sq. m) maximum.

E. Panel Thickness: Not less than 3 inches (75 mm).

F. Panel Closure: Manufacturer's standard.

1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal or as indicated.
2. Final Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.

G. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

2.4 SEALS

A. General: Provide types of acoustical seals indicated that produce operable panel partitions complying with acoustical performance requirements and the following:

1. Seals made from materials and in profiles that minimize sound leakage.

B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.

C. Horizontal Top Seals: Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track when extended.

D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.

1. Automatically Operated: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than 1-inch (25-mm) between retracted seal and floor finish.

2.5 FINISH FACING

A. General: Provide finish facings that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.

1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects.

B. High-Pressure Decorative Laminate: NEMA LD 3, Horizontal grade.

C. Paint: Manufacturer's standard factory-painted finish.

2.6 SUSPENSION SYSTEMS

A. Suspension Tracks: Steel or aluminum mounted directly to overhead structural support, with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.54 mm) between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

1. Multidirectional Carriers: Capable of negotiating 90-degree L, T, and X intersections without track switches.

C. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish, unless otherwise indicated.

D. Steel Finish: Factory-applied, corrosion-resistant, protective coating, unless otherwise indicated.

2.7 ACCESSORIES

A. Pass Doors: Fabricated to comply with recommendations in ANSI A117.1, Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)." Swinging door built into and matching panel materials, construction, acoustical qualities, finish, and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.

1. Single Pass Door: 36 by 84 inches (914 by 2134 mm), with the following:

a. Door Seals: Mechanically operated floor seal on panels containing pass doors.
b. Panic hardware.
c. Concealed door closer.
d. Lock: Deadlock to receive cylinder, operable from both sides of door. Refer to Division 8 door hardware Sections for lock cylinder and keying requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with operable panel partition manufacturer's written installation instructions.

B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.

C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

3.3 ADJUSTING

A. Adjust operable panel partitions to operate smoothly, without warping or binding. Lubricate hardware, and other moving parts.

B. Adjust pass doors to operate smoothly and easily, without binding or warping. Check and readjust operating hardware. Confirm that latches and locks engage accurately and securely without forcing or binding.

3.4 FIELD QUALITY CONTROL

A. Light Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids; adjust partitions for acceptable fit.

3.5 CLEANING

A. Clean soiled surfaces of operable panel partitions to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

END OF SECTION 10651

SECTION 10801 - TOILET AND BATH 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. Public-use washroom accessories.
2. Custodial accessories.

B. Related Sections include the following:

1. Division 6 Section "Miscellaneous Carpentry" for blocking and backing required for toilet and bath accessories installation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Drawings.
2. Identify products using designations indicated on Drawings.

C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.

B. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

C. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

D. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

E. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

F. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products scheduled by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. General Accessory Manufacturing Co. (GAMCO).

B. Toilet Tissue (Roll) Dispenser:

1. Description: Scheduled dispenser at locations indicated.

C. Paper Towel (Folded) Dispenser:

1. Description: Scheduled dispenser at locations indicated.

D. Waste Receptacle:

1. Description: Scheduled receptacle at locations indicated.

E. Combination Towel Dispenser/Waste Receptacle:

1. Description: Scheduled dispenser/receptacle at locations indicated.

F. Liquid-Soap Dispenser:

1. Description: Scheduled dispenser at locations indicated.

G. Grab Bar:

1. Description: Scheduled grab bars at locations indicated.
2. Mounting: Flanges with concealed fasteners.
3. Configuration and Length: As indicated on Drawings.

H. Mirror Unit:

1. Basis-of-Design Product: As Scheduled on Drawings.
2. Frame: Stainless-steel channel.

a. Corners: Manufacturer's standard.

3. Hangers: Produce rigid, tamper- and theft-resistant installation.
4. Size: As indicated on Drawings.

2.3 CUSTODIAL ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. General Accessory Manufacturing Co. (GAMCO).

C. Mop and Broom Holder:

1. Basis-of-Design Product: As Scheduled.
2. Description: Unit with hooks and holders.
3. Length: 36 inches (914 mm), unless otherwise indicated.
4. Hooks: Three.

5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 finish (satin).

2.4 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. 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. Grab Bars: Install 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. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10801

SECTION 12484 - FLOOR MATS 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 the following:

1. Carpet-type mats/tiles.

B. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for Owner's SPiRiT requirements.
2. Division 3 Sections "Cast-In Place Concrete", including forming, placing, and finishing concrete floor slabs, and for concrete materials for grouting and filling around and under recessed mats and frames.

1.3 SUBMITTALS

A. Product Data: Include manufacturer's specifications and installation instructions, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of floor mat and frame specified.

B. Samples for Verification: 12-inch-(300-mm-) square assembled sections of floor mats, frame members, and tread rails with selected tread surface showing each type of metal finish and color of exposed floor mats, tread rails, frames, and accessories required.

C. Maintenance Data: For cleaning and maintaining floor mats to include in maintenance manuals.

D. SPiRit Submittals:

1. SPiRiT Credit: MR 4.C4, recycled material content.
2. SPiRiT Credit: IEQ 5.C4, Low-Emitting Materials, Adhesives/Sealants.
3. SPiRiT Credit: IEQ 5.C4, Low-Emitting carpets and backings.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain floor mats and frames through one source from a single manufacturer.

B. Accessibility Requirements: In addition to requirements of authorities having jurisdiction, provide installed floor mats that comply with Section 4.5 in the U.S. Architectural &

Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify blocked-out openings in floors 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 floor mats and frames without field measurements. Coordinate floor construction to ensure that actual opening dimensions correspond to established dimensions.

1.6 COORDINATION

A. Coordinate size and location of oversized recesses in concrete work to receive floor mats.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpet-Type Mats:

a. The Anderson Company—Waterhog tiles, or approved equal.

2.2 FLOOR MATS

A. General: Provide colors, patterns, and profiles of materials, including metals and metal finishes indicated or specified. If not indicated, provide colors, patterns, and profiles selected by Architect from manufacturer's standards.

1. Carpet-Type Mats/Tiles: Waterhog Tile Square Pattern Product # 210 Pile height ¼".

2.3 FABRICATION

A. General: Where possible, verify sizes by field measurement before shop fabrication.

B. Floor Mats: Shop fabricate units to greatest extent possible in sizes as indicated. If not otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, and floor conditions, and floor recesses for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.

1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

B. Defer installation of floor mats until Project is near Substantial Completion.

END OF SECTION 12484

SECTION 12491 - HORIZONTAL LOUVER BLINDS

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. Horizontal louver blinds with aluminum slats.

B. Related Sections include the following:

1. Division 6 Section "Miscellaneous Carpentry" for wood blocking and grounds for mounting horizontal louver blinds and accessories.

1.3 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for horizontal louver blinds.

C. Samples for Initial Selection: For each type and color of horizontal louver blind indicated.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type and color of horizontal louver blind indicated.

1. Slat: Not less than 12 inches (300 mm) long.
2. Tapes: Full width, not less than 6 inches (150 mm) long.
3. Horizontal Louver Blind: Full-size unit, not less than 16 inches (400 mm) wide by 24 inches (600 mm) long.
4. Valance: Full-size unit, not less than 12 inches (300 mm) wide.
5. Cornice: Full-size unit, not less than 12 inches (300 mm) wide.

E. Window Treatment Schedule: For horizontal louver blinds. Use same designations indicated on Drawings.

F. Product Certificates: For each type of horizontal louver blind, signed by product manufacturer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for each type of horizontal louver blind.

H. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide horizontal louver blinds 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. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Flame-Resistance Ratings: Passes NFPA 701.

C. Product Standard: Provide horizontal louver blinds complying with WCSC A 100.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver horizontal louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, lead-free designation, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where horizontal louver blinds 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.

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. Horizontal Louver Blinds: Before installation begins, for each size, color, texture, pattern, and gloss indicated, full-size units equal to 5 percent of amount installed but no fewer than two units.

PART 2 - PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:

1. Hunter Douglas.
2. Levolor, a Newell Rubbermaid Company.
3. Springs Window Fashions Division, Inc.
4. Approved equal.

C. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.

1. Width: 1 inch (25 mm).

a. Spacing: Every 0.71 inch (18 mm).

2. Thickness: Manufacturer's standard.
3. Finish: One color.

a. Ionized Coating: Antistatic, dust-repellent, baked polyester finish.
b. Reflective Coating: Manufacturer's special coating enhancing the reflection of solar energy on the outside-facing slat surface.

D. Perforated Slats: Openness factor of 6 to 7 percent, edges returned or rolled; fully enclosing operating mechanisms on three sides and end plugs and the following:

1. Capacity: One blind per headrail.
2. Integrated Headrail/Valance: Curved face.

E. Bottom Rail: Formed-steel or extruded-aluminum tube, with plastic or metal capped ends enclosed ladders and tapes to prevent contact with sill. top contoured to match crowned shape of slat [bottom contoured for minimizing light gaps; with

F. Ladders: Evenly spaced to prevent long-term slat sag.

1. For Blinds with Nominal Slat Width 1 Inch (25 mm) or Less: Braided string.

a. Tape Color, Texture, and Pattern: Color, texture, and pattern as indicated by manufacturer's designations.

G. Lift Cords: Manufacturer's standard.

H. Tilt Control: Enclosed worm-gear mechanism, slip clutch or detachable wand preventing overrotation,] and linkage rod, and the following:

1. Tilt Operation: Manual with clear plastic wand.

2. Length of Tilt Control: Manufacturer's standard length required to make operation convenient from floor level.
3. Tilt: Full.

I. Lift Operation: Manual, cord lock; locks pull cord to stop blind at any position in ascending or descending travel.

J. Tilt-Control and Cord-Lock Position: Right and left side of headrail, respectively.

K. Valance: Manufacturer's standard.

1. Finish Color Characteristics: Match color, texture, pattern, and gloss from slats as selected by Architect from manufacturer's full range.

L. Wall extension brackets , permitting easy removal and replacement without amaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment indicated.

2. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blind.

L. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.

M. Side Channels and Perimeter Light Gap Seals: Manufacturer's standard.

N. Colors, Textures, Patterns, and Gloss: As selected by Architect from manufacturer's full range.

2.2 HORIZONTAL LOUVER BLIND FABRICATION

A. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.

B. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Blind Units Installed between (inside) Jambs: Width equal to 1/4 inch (6 mm) per side or 1/2 inch (13 mm) total, plus or minus 1/8 inch (3.1 mm), less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm), less than head-to-sill dimension of opening in which each blind is installed.

C. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware, and for hardware position and blind mounting method indicated.

D. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.

E. Color-Coated Finish:

1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
2. Wood: Apply manufacturer's standard factory-applied finish complying with manufacturer's written instructions for surface preparation, application, and minimum dry film thickness.

F. Component Color: Provide rails, cords, ladders, and exposed-to-view metal[, wood,] and plastic matching or coordinating with slat color, unless otherwise indicated.

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.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install horizontal louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior slat edges in any position are not closer than 1 inch (25 mm) to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware if any.

B. Head Mounted: Install headrail on face of opening head.

3.3 ADJUSTING

A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free of binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean horizontal louver blind 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 horizontal louver blinds are without damage or deterioration at time of Substantial Completion.

C. Replace damaged horizontal louver blinds 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. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 12491

SECTION 12494 - 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 Black-Out roller shades.

B. 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 shade indicated.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification:

1. Complete, full-size operating unit not less than 16 inches (400 mm) wide for each type of roller shade indicated.
2. For the following products:

a. Shade Material: Not less than 3 inches (76 mm) square, with specified treatments applied. Mark face of material.
b. Valance: Full-size unit, not less than 12 inches (300 mm) long.

E. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.

F. Product Certificates: For each type of roller shade, signed by product manufacturer.

G. Qualification Data: For Installer.

H. Product Test Reports: For each type of roller shade.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by independent testing agency.

J. 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: Fabricator of products.

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.

D. Product Standard: Provide roller shades complying with WCMA A 100.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same 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.

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. Rollers Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal to 5 percent of amount installed, but not fewer than two units.

PART 2 - PRODUCTS

2.1 ROLLER SHADES

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. Am-Source International.
2. BTX Window Automation, Inc.
3. Custom Laminations, Inc..
4. Draper Inc.
5. Hunter Douglas, Inc.; Hunter Douglas Window Fashions Division.
6. Levolor; Levolor-Kirsch Window Fashions; a Newell Rubbermaid Company.
7. Lutron Shading Solutions by VIMCO.
8. MechoShade Systems, Inc..
9. Nysan Shading Systems Ltd.
10. Shade Techniques, Inc.
11. Sol-R-Veil.
12. Verosol USA, Inc.; OEM Shades Inc.
13. Approved equal.

B. Shade Band Material: PVC-coated fiberglass and polyester blends.

1. Fabric Width: As indicated on Drawings.
2. Colors: Black.
3. Material Openness Factor: 0 percent.
4. Material UV Blockage: !00 percent.
5. Bottom Hem: Straight.
6. Trim: As indicated by manufacturer's designation for style and color.

C. 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 manufacturer's standard method for attaching shade material. Provide capacity for one roller shade band(s) per roller, unless otherwise indicated on Drawings.

D. Direction of Roll: Regular, from back of roller.

E. Mounting Brackets: Fascia end caps, fabricated from steel finished to match fascia or headbox.

F. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated on Drawings; removable design for access.

G. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide exposed-to-view, external-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

H. Audiovisual Light-Blocking Shades: Designed for eliminating all visible light gaps when shades are fully closed; fabricated from blackout shade band material with fascia and bottom bar extended and formed for light-tight joints among shade components and between shade components and adjacent construction.

1. Side Channels, Sill Channel or Angle, and Perimeter Seals: Manufacturer's standard design, including sill light seal attached to bottom bar, for eliminating light gaps when shades are closed.
2. Shade Band Retention System: Manufacturer's standard design for guiding shade band material through range of travel and holding shade band flat with edges of material within side channels.

I. Valance: As indicated by manufacturer's designation for style and color.

J. Mounting: Inside, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

K. Hold-Down Brackets and Hooks or Pins and] [Side Channels: Manufacturer's standard for fixing shade in place, keeping shade band material taut, and reducing light gaps when shades are closed.

L. Shade Operation: Manual; with continuous-loop bead-chain, clutch, and cord tensioner and bracket lift operator.

1. Position of Clutch Operator: Left side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.
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: Nickel-plated metal.

2.2 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 between (Inside) Jambs: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.

D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, roller, and operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: No 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. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range otherwise indicated.

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.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units 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.

B. Connections: Connect motorized operators to building electrical system.

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 roller shades. Refer to Division 1 Section Demonstration and Training."

END OF SECTION 12494

SECTION 14240 - HYDRAULIC ELEVATORS

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 hydraulic passenger elevators.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
2. Division 4 Section "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry.
3. Division 5 Section "Structural Steel" for the following:
    a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    b. Divider beams.
    c. Structural-steel shapes for subsills that are part of steel frame.
4. Division 5 Section "Metal Fabrications" for the following:
    a. Attachment plates and angle brackets for supporting guide-rail brackets.
    b. Divider beams.
    c. Structural-steel shapes for subsills that are not part of steel frame.
    d. Pit ladders.
5. Division 9 Section "Painting" for field painting of hoistway entrances.
6. Division 9 Section "Ceramic Tile" for finish flooring in elevator cars.
7. Division 13 Section "Fire Alarm" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.
8. Division 16 Section "Premises Telephone Wiring" for telephone service to elevators by Design-Build Electrical Contractor.
9. Division 16 Sections for electrical service for elevators to and including fused disconnect switches at machine room door and standby power source, transfer switch, and connection from auxiliary contacts in transfer switch to controller by Design-Build Electrical Contractor.

1.3 DEFINITIONS

A. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the 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.

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. 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 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.

D. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service are adequate for elevator system being provided.

E. Maintenance Manuals: Include operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at Project closeout as specified in Division 1.

F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or an experienced installer approved by elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Regulatory Requirements: In addition to local governing regulations, comply with applicable provisions in ASME A17.1, "Safety Code for Elevators and Escalators."

1. Seismic Risk Zone: Project is located in Building Seismic Design Category D].

C. Accessibility Requirements: In addition to local governing regulations, comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and Section 407 in ICC A117.1.

1.6 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 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.

1.7 WARRANTY

A. Special Manufacturer's Warranty: Written warranty, signed by manufacturer agreeing to repair, restore, or replace defective elevator work within specified warranty period.

1. Warranty Period: 12 months from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled employees of the 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 as 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 yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering hydraulic elevators that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide hydraulic elevators by one of the following:

1. KONE Inc.
2. Fujitec America, Inc.

3. Montgomery KONE Inc.
4. Otis Elevator Co.
5. Schindler Elevator Corp.
6. Schumacher Elevator Co.
7. Thyssen Elevator Group North America.
8. U S Elevator.

2.2 MATERIALS 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 a 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 either of the following:

1. Pump, with fan-cooled squirrel-cage induction motor, mounted on top of oil tank with vibration isolation mounts. Enclose pump in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.
2. Provide motor with wye-delta or solid-state starting.

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. 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 Specification Section.

F. Car Frame and Platform: Welded steel units.

G. Finish Materials: Provide the following materials and finishes for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated:

1. Satin Stainless Steel: ASTM A 666, Type 304, with No. 4, directional satin finish.
2. Prime-Painted Steel Sheet: Cold-rolled steel sheet, ASTM A 366/A 366M, or hot-rolled steel sheet, ASTM A 569/A 569M, with factory-applied rust-inhibitive primer.
3. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGP for postformed applications and Type HGS for flat applications; color, texture, and pattern as selected by Architect from plastic-laminate manufacturer's full range of products.

2.3 OPERATION SYSTEMS

A. Passenger Elevators: Provide manufacturer's standard microprocessor operation system for each elevator or group of elevators as required to provide type of operation system indicated.

1. Single Elevator, Two Stops: Provide "automatic operation" as defined in ASME A17.1.
2. Loaded-Car Bypass: When car load exceeds a predetermined weight, car will respond only to car calls, not to hall calls. Predetermined weight can be adjusted.
3. Automatic Dispatching of Loaded Car: When car load exceeds a predetermined weight, doors will begin closing.

B. Security Features: In addition to above operational features, provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Keyswitch Feature: Car and hall push buttons are activated and deactivated by security keyswitches. Key is removable only in deactivated position.

2.4 SIGNAL EQUIPMENT

A. General: Provide signal equipment for each elevator or group of elevators with hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements of acrylic or other permanent, nonyellowing translucent plastic.

B. Car Control Stations: Provide manufacturer's standard semirecessed car control stations. Mount in return panel adjacent to car door, if not otherwise indicated.

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 (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. Fire Department Communication System: Provide telephone jack in each car and required conductors in traveling cable for fire department communication system specified in Division 16 Sections.

E. Car Position Indicator: For passenger elevator cars, provide illuminated-signal type, digital-display type, or segmented type, 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 elevator or group of elevators, but not less than one station for each four elevators in a group. For each group of passenger elevators, locate between two elevators at center of group or at location most convenient for approaching passengers.

G. Hall Lanterns: Provide units with illuminated arrows, but provide single arrow at terminal landings.

H. Hall Position Indicators: Provide illuminated-signal type or digital-display type, located above each hoistway entrance at ground floor. Provide units with flat faceplate for mounting with body of unit recessed in wall.

1. Integrate ground-floor hall lanterns with hall position indicators.

I. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations with text and graphics according to ASME A17.1, Appendix H.

2.5 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening devices with a 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.

2.6 PASSENGER ELEVATOR CAR ENCLOSURES

A. General: Provide manufacturer's standard steel-framed car enclosures with nonremovable wall panels, suspended ceiling, trim, accessories, access doors, doors, power door operators, sills (thresholds), lighting, and ventilation.

1. Floor finish is specified in another Section.
2. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch (13-mm) fire-retardant-treated particleboard with plastic-laminate panel backing complying with NEMA LD 3, Type BKV and manufacturer's standard protective edge trim. Panels have a flame-spread rating of 25 or less, when tested according to ASTM E 84.
3. Fabricate car with recesses and cutouts for signal equipment.
4. Fabricate car door frame integrally with front wall of car.
5. Stainless-Steel Doors: Flush, hollow-metal construction, fabricated from stainless steel.
6. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
7. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic complying with flammability requirements.
8. Handrails: Manufacturer's standard handrails, of stainless steel.

2.7 PASSENGER 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.

B. Materials and Fabrication: Provide manufacturer's standards but not less than the following:
1. Stainless-Steel Frames: Formed stainless-steel sheet.
2. Stainless-Steel Doors: Flush, hollow-metal construction, fabricated from stainless steel.
3. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
4. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

2.8 PASSENGER ELEVATORS

A. Elevator:
1. Type: Holeless, single-acting, beside-the-car, dual cylinder.
2. Rated Load: 2500 lb (1134 kg) .
3. Rated Speed: 100 fpm (0.51 m/s).

4. Operation System: Selective collective (Simplex) automatic operation.
5. Auxiliary Operations:

   a. Standby power operation.
   b. Standby powered lowering.
   c. Battery-powered lowering.
   d. Loaded-car bypass.
   e. Automatic dispatching of loaded car.

6. Security Features: Keyswitch feature.
7. Car Enclosures: As follows:

   a. Inside Width: 80 inches (2032 mm).
   b. Inside Depth: 51 inches (1448 mm.
   c. Front Walls: Satin stainless steel with integral car door frames.
   d. Car Fixtures: Satin stainless steel.
   e. Side and Rear Wall Panels: Plastic laminate.
   f. Reveals: Enameled steel.
   g. Door Faces (Interior): Satin stainless steel.
   h. Door Sills: Aluminum.
   i. Ceiling: Luminous ceiling.
   j. Handrails: Satin stainless steel, at side and rear walls.
   k. Floor recessed and prepared to receive ceramic tile (specified in Division 9 Section "Dimension Stone Tile"). Provide cementitious backer units applied over 5/8-inch (16-mm) underlayment grade, exterior plywood, screwed to car platform.

8. Hoistway Entrances: As follows:

   a. Width: 42 inches (1067 mm).
   b. Height: 84 inches (2134 mm).
   c. Type: Single-speed center opening.
   d. Frames Satin stainless steel.
   e. Doors Satin stainless steel.
   f. Sills Aluminum.

9. Hall Fixtures Satin stainless steel.
10. Additional Requirements: As follows:

   a. Provide inspection certificate in each car, mounted under acrylic cover with satin stainless-steel frame.
   b. Provide protective blanket hooks in cars and one complete sets of full-height 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. Proceed with installation only after unsatisfactory conditions have been corrected.

1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance.

3.2 INSTALLATION

A. 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.

B. 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.

C. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cement fittings.

D. Install piping above the floor, where possible. Where not possible, cover underground piping with permanent protective wrapping before backfilling.

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 cars. 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.

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.

3.4 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of operational failure and other building emergencies. Train Owner's personnel in

procedures to follow in identifying sources of operational failures or malfunctions. Confer with Owner on requirements for a complete elevator maintenance program.

B. Make a final check of each elevator operation with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

3.5 PROTECTION

A. Temporary Use: Do not use elevators for construction purposes unless cars are provided with temporary enclosures, either within finished cars or in place of finished cars, to protect finishes from damage.

1. Provide full maintenance service by skilled, competent employees of elevator Installer for elevators used for construction purposes. Include 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. Use same parts and supplies as used in the manufacture and installation of original equipment.
2. Provide protective coverings, barriers, devices, signs, and other procedures to protect elevators. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so that no evidence remains of correction work. 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.

END OF SECTION 14240

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15010 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Basic requirements common to the work in general of Division 15 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 15.

C. SPiRiT Compliance: This project is to meet or exceed the Gold Level of the U.S. Army Corps of Engineers' Sustainable Project Rating Tool (SPiRiT). Contractor shall be familiar with these requirements and provide all necessary work, systems, and equipment to achieve the following SPiRiT points:

1. 3.R1 Fundamental Building Systems Commissioning
2. 3.R2 Minimum Energy Performance (meet ASHRAE/IESNA 90.1-1999)
3. 3.R3 CFC Reduction in HVAC&R Equipment
4. 3.C1 Optimize Energy Performance (25% reduction in energy usage)
5. 3.C5 Measurement and Verification
6. 5.R1 Minimum IAQ Performance
7. 5.C1 IAQ Monitoring
8. 5.C3 Contruction IAQ: Management Plan
9. 5.C3 Contruction IAQ: Flush-out or testing
10. 5.C7 Thermal Comfort: Temperature & Humidity
11. 5.C7 Thermal Comfort: Monitor/Control
12. 5.C9 Acoustic Environment/Noise Control

D. During construction meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings under Construction, 1995, AND protect stored on-site or installed absorptive materials from moisture damage, AND replace all filtration media immediately prior to occupancy (Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-1999).

E. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the work even though not specified or indicated.

F. Inspection: Inspect work preceding or interfacing with work of Division 15 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.

G. 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 15000 work.

1.2 RELATED WORK

A. Requirements: Provide Basic Requirements in accordance with the Contract Documents.

1.3 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 15 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 Division 15 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 15 Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the Division 15 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.

1.4 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 as the date of the Contract Documents, except when a specific date is specified.
3. When required by individual Specifications section, obtain copy of standard. Maintain copy at job site during work until substantial completion.

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
USACE	United States Army Corps of Engineers 441 G. Street, NW Washington, DC 20314 www.usace.army.mil

1.5 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 15 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.

1.6 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 15 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 15990 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.

1.7 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

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.

1.8 SUBMITTALS

A. 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 15 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 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 15 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: No action required. Submittals are accepted as submitted.
2. Approved as 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 Engineer's approval does not relieve Contractor from being ultimately responsible for ensuring that submitted items satisfy all requirements of the Contract Documents.

1.9 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 15 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 15 Contractor.

1.10 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
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. Shop Drawings: Maintain shop drawings as record documents recording changes made after review as specified for drawings above.

G. Submittal: At completion of project, deliver record documents to Owner's representative and transmit a copy of signed receipt from Owner to the Engineer.

1.11 OPERATING AND MAINTENANCE DATA

A. Division 15 Contractor shall submit five (5) typed and bound copies of the maintenance manual, 8-1/2" x 11" in size, to the Mechanical Consulting Engineer for approval. These approved copies will be returned to the Contractor and shall then be transmitted to the Owner.

B. Organization of the manuals shall follow the recommendations in ASHRAE Guideline 4-1993.

C. The manual shall be enclosed in a stiff-back, three-ring binder and shall have:

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 necessary cleaning/replacing/adjusting schedules.
4. All test reports and proof of performance certificates.
5. Manufacturer's data on each piece of equipment, including the following. Provide original printed material in each book, faxes and photocopies are NOT acceptable.

a. Installation instructions.
b. Drawings and specifications (final shop drawings).
c. Parts lists.

d. Complete "as-built" wiring and temperature control diagrams. (Shop drawings are not acceptable.)
e. Lubrication and other preventative maintenance data.
f. Equipment warranties.

D. 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 15050.
3. Provide a typed tag list or schedule laminated or mounted under plexiglass in the equipment room stating number, location, and function of each tagged item. Insert a copy of tag list in each "Maintenance Manual".
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 15050. Mount all drawings under plexiglass or laminate and mount on equipment room wall.

E. Division 15990 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. 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.

1. Submit training certificate to Owner's Representatives at end of training and have certificate signed by Owner's Representative to indicate adequate training has been received.

1.12 OPERATING AND MAINTENANCE MANUALS

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 approved submittals shall be included for all equipment items.

B. Three sets <five sets for DFCM Projects> 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, marked with model and size and plan symbol.

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. Owner 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 "6" through "8" need not be printed on the backbone.

I. Include a Table of Contents and tabbed index dividers.

1.13 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.

1.14 PROJECT CONDITIONS

A. Accessibility:

1. Division 15 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 cooperate with Contractors of other Divisions of the Work whose work is in the same space and shall advise the Construction Manager/General Contractor of his requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
2. Division 15 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 15 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.

B. Fabrication:

1. Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the Contractor shall 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.

1.15 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 15050.

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 15050.

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 15 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.

1.16 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.

1.17 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 15 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 15 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 15990 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.

1.18 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 15 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 15511 Contractor shall be responsible to certify that all HVAC Piping Systems have been cleaned in accordance with Section 15548 - HVAC Water Treatment whether actually done by the Section 15511 Contractor or by the 15548 Contractor.

1.19 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.

1.20 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.

1.21 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.

1.22 UNIT PRICES

A. Refer to Section 01151 - Unit Prices where scope and description of unit prices are given.

END OF SECTION 15010

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

CONFIDENTIAL

(For CEA Use Only)

MECHANICAL COST BREAKDOWN

(Rounding off to the nearest $500 is acceptable)

PROJECT NAME: UNG – CAMP WILLIAMS 144TH READINESS CENTER

BID DATE: (month/year) _____ CEA PROJECT NO.: 2004-087.00

SUBCONTRACTOR NAME: _____

HVAC Equipment:	$
HVAC Piping Material and Labor:	$
Sheet Metal Equipment:	$
Sheet Metal Material and Labor:	$
Insulation:	$
Plumbing Equipment and Fixtures:	$
Plumbing Piping Materials and Labor:	$
Automatic Temperature Control:	$
Testing, Adjusting and Balancing:	$
Fire Protection:	$
*Medical Gases:	$
*Medical Gas Certification:	$
*Clean Room Certification:	$
*Process Piping Materials and Labor:	$
*Site Utilities Piping:	$

A completed copy of this form MUST be forwarded to the Engineer before any shop drawings/submittal will be reviewed. See Section 15010, 1.8, A.

Fax or mail completed form to:

Colvin Engineering Associates, Inc.
244 West 300 North, Suite 200
Salt Lake City, Utah 84103
(801) 322-2400 - Phone
(801) 322-2416 – Fax

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15050 - 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 15050.

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 15 and other Divisions and Sections of the Specifications where referenced.

1.3 QUALITY ASSURANCE

A. 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.

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 <per University of Utah Campus Design and Construction Standards>.
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 15010.

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 15910 or Division 16 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 16 and with individual equipment requirements specified in other Sections of Division 15. 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 85% under rated load conditions. The 85% PF may be obtained by design of the motor or by providing a capacitor. Capacitors, if provided to obtain the 85% PF, must be switched with the motor. If the motor draws less than 1000 watts at full load, it is excluded from the 85% 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 energy efficient 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 15 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 15 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 16. 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 15.** Approved manufacturers shall be those listed in Division 16 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 16000 will be accepted. All starters shall comply with Division 16000 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 15955-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.

2.3 ACCESS DOORS

A. Furnish steel access doors, minimum size required for normal service use or as sized on drawings as manufactured by Inryco/Milcor, Walsh, Hannan, or Gladwin Co., 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.

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: Hammond, Powell, Milwaukee, Walworth, Crane, Nibco.
   b. Iron Body Valves: Hammond, Powell, Milwaukee, Traverse City, Kennedy, Iowa, American, Nibco.
   c. U.L., F.M. Approved or Listed Valves: Hammond, Milwaukee, Nibco, Demco, Pratt, Kennedy, Mission.
   d. Ball Valves: Hammond, Nibco, Watts, Jamesbury, Worcester, Milwaukee, Apollo, Powell, Dynaquip, Spirax Sarco.
   e. Butterfly Valves: Milwaukee, Hammond, Centerline, DeZurik, Fisher, Victaulic, Keystone, Posi-Seal, TEC, Flowseal, Nibco.
   f. Lubricated Plug Valves: Homestead, Nordstrom, Powell, Walworth.
   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.

C. Valve Schedule:

1. Standard Bronze Valves - 150 SWP/300 CWP, per ASTM B61/62. 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. Sfandard 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. Ball 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-585-70-66	T-585-70-66	--	T595-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:	416 stainless steel
Seat:	EPDM (-40 deg.F to 250 deg.F)
Actuator:	2" thru 5" Infinite position lever with memory stop. 6" thru 20" Self-locking worm gear with adjustable limit stops, and position indicator. Provide chain wheel and chain where indicated by contract documents.
Make:	Keystone
Size:	2"-12" 14"-20"
Model:	228 122

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).

B. Material:

1. Hangers in contact with steel, iron, cast or ductile iron shall be hot dipped galvanized or cold galvanized with "ZRC" cold galvanized compound only to a thickness of not less than 3.0 mil (.003 inches). "ZRC" cold galvanizing compound is manufactured by ZRC Chemical Products Co., Quincy Mass.
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
1/2" thru 3"	12"	18	galvanized
4"	12"	16	galvanized

* Insulation inserts between piping and shield shall be furnished by 15250 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 in the following schedule are based on combined bending and shear stress of 1500 psi when the pipe is filled with water and 1/10-inch deflection allowance between supports, all valves, heavy fittings and changes in direction of piping shall be additionally supported with hangers each side of valves and heavy fittings, and one additional support within one foot of the directional change. Where more stringent hanger spacing and rod sizes are required by jurisdictional authority, the more stringent requirements shall supercede the following schedule.

Nominal Pipe or Tubing Size	Maximum Support Spacing Center to Center (ft)	Minimum ATR or MTR rod dia (in)
½" thru 1"	6	3/8"
1-1/4" thru 2"	7	3/8"
2-1/2" thru 3"	10	1/2"
4"	14	5/8"

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).
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.

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. P.H.D.
e. Michigan
f. 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. Semi-rigid Plastic Identification Pipe Markers: Seton Setmark with legend, size and color coding per ANSI A13.1 Direction of flow arrows are to be included on each marker, unless otherwise specified.

a. Setmark Type Snap-Around markers to be used on diameters 3/4" thru 5".
b. Setmark Type Strap-Around markers to be used on diameters 6" or larger.

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"
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, 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 sepoint.
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 15. Installation of cable on pipe including splices, strapping and bulb placement shall be by division 15 Contractor.
2. Installation of power wiring including breakers and mounting thermostat enclosure shall be part of the Work included in Division 16.
3. Work under Division 15 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 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.

1. Fittings: Galvanized cast iron, or ANSI/ASTM B16.3 malleable iron.
2. Joints: Screwed, or grooved mechanical couplings.

B. 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.

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.

B. Protection:

1. Close ends of pipe and ductwork during construction 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 15240 - Mechanical Sound and Vibration Control under all conditions of load.
2. Sound or vibration conditions not in accordance with Section 15240 and considered objectionable shall be corrected in a manner approved by the Architect under the Work of Division 15.

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 15 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 16 for electrical work of this Division 15 which is not otherwise specified. No extras will be allowed for Contractor's failure to provide for these required items. The Division 15 Contractor shall also refer to the Division 16 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

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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 in MCC	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
Control Relays & Transformers for control power	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
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 full load currents.	MC	EC	EC	N/A
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
Temporary Heating Connections	MC	MC	EC	MC
Freeze Protection Heat Cable	MC	MC	EC	MC

* MC = Mechanical Contractor under Division 15 of the work.
* FM = Mechanical Contractor under Section 15365 - FM-200 Fire Suppression System.
* FPC = Fire Protection Contractor.

* EC = Electrical Contractor under Division 16 of the work.
* MGES = Medical Gas Equipment Supplier (Section 15484).

D. All temperature control conduit and wiring shall be furnished and installed under Section 15955. All motorized damper and motorized valve wiring shall be furnished and installed under Section 15955.

3.4 SLEEVES, PLATES AND CLOSURES

A. Division 15 Contractor shall provide and locate pipe sleeves, and inserts 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.

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.

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.
3. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor.
4. 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.

D. 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.

E. 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.

F. 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.

G. 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.

H. 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 15 Contractor.

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 15 Contractor shall verify all openings required in the new construction in connection with the work under Division 15 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 15 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 15 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.

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 15241 - 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.

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. 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 15 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. Pressure Sensitive Markers: Apply pressure sensitive markers in accordance with manufacturer's recommendations with complete wrap around may be used at Contractor's option. Marker adhesion will be tested for permanence. Any markers showing dog ears, bubbles, or other failings shall be replaced.
4. Semi-Rigid Plastic Identification Markers: Seton Setmark premolded (not pressure sensitive) identification markers may be used at Contractor's option on service piping which is accessible for maintenance operations (but not on piping in finished spaces). This type marker shall not be installed on bare pipe when surface temperature exceeds 180 deg.F unless a 1" thick insulation band is first provided under marker for protection from the hot pipe.

C. Identification of Piping: Identify all piping accessible for maintenance, as well as exposed to view utilizing semi-rigid plastic markers, 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. 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 shall be identified by 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 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 15250.

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, heating 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 15050 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 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 shall be installed and maintained. Before building acceptance by Owner, these units shall be thoroughly cleaned 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.

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.

END OF SECTION 15050

Utah National Guard
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SECTION 15240 - 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 15010 - Basic Mechanical Requirements

Section 15050 - Basic Mechanical Materials and Methods

Section 15511 - HVAC Piping & Specialties

Section 15900 - 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 15 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 15990 Contractor in compliance with the Section 15990 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
main supply and return duct shafts --------- RC-40

Lobbies, Toilets, Commons Area ---------- RC-40

Garage ---------- RC-50-60

Mechanical Rooms ---------- RC-60-80

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 10-12 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 10-12 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.

B. Other acceptable manufacturers offering equivalent products: Korfund, Amber/Booth Co., Vibration Mountings and Control Co., Kinetics.

C. 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.

D. 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.

E. 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.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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.

K. 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 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 plug fan discharge plenum and where shown on Drawings. Liner shall be 26 gauge steel with perforated 28% minimum open area.

2.3 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.

2.4 NON-HARDENING CAULKING

A. Acceptable Products: Tremco "Polybutene", Schuller or accepted equal.

B. Guaranteed to be permanently elastic.

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 15511.

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 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 ductwork sound linings:

1. 10'-0" Downstream of VAV boxes.
2. Transfer air ducts and shaft return stub ducts.
3. In all return ducting.
4. Return air elbow boots over ceiling grilles.
5. In plenums above supply diffusers.
6. Elsewhere when specifically indicated on drawings.

E. Extent of plenum sound linings:

1. Return/Exhaust air plenums inside packaged rooftop units when not factory installed.

F. Extent of perforated metal facing on sound linings:

1. In supply air fan discharge plenums inside packaged rooftop units when not factory installed.
2. In high velocity supply air ducts where shown on drawings.

3.8 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.

3.9 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.

3.10 EQUIPMENT MOUNTING SCHEDULE

A. Manufacturer: Mason Industries, Inc.

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

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

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

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 = THRUST RESTRAINT
6 = 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.)
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

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

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NOTES:

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END OF SECTION 15240

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15241 - MECHANICAL SEISMIC CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Anchorage and seismic restraint systems for all Division 15 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. Unit Heaters
4. Radiant Heaters
5. Boilers
6. Air Separators
7. Expansion Tanks
8. Supply Air Fans
9. Hanging Exhaust Fans
10. Pumps
11. Fan Coil Units
12. Air Handling Units
13. Domestic Water Heaters

1.2 RELATED WORK

A. Requirements: Provide Mechanical Seismic Control in accordance with the Contract Documents.

B. Section 15010 - Basic Mechanical Requirements.

C. Section 15050 - Basic Mechanical Materials and Methods.

D. Section 15240 - 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 15 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 I.
2. Short period design spectral response acceleration coefficient S_{DS}= 0.813g.
3. One-second period design spectral response acceleration coefficient S_{D1}= 0.471g.
4. Site Class D.
5. Seismic Design Category D.

B. All other components have an importance factor 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 submitted for earthquake bracing and anchors shall bear the Engineer's signed professional seal. All calculations/design work required for the seismic anchorage and restraint of all Division 15 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 15 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 section 1.04 above, with direct anchorage capability.

1.6 SUBMITTALS

A. A single submittal shall be provided for all seismic anchorage and restraints for all Division 15 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 15241-1.1 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

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 15240.

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.

B. 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.

C. Non-Isolated Equipment:

1. The Division 15241 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.

D. 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.

E. 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 hangers and hangers are 12 inches or less in length from the top of the duct to the supporting structure.
   b. HVAC ducts have a cross-sectional area of less than 6 square feet.

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 15241

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15250 - 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 15010 - Basic Mechanical Requirements
Section 15050 - Basic Mechanical Materials and Methods
Section 15240 - Mechanical Sound and Vibration Control
Section 15450 - Plumbing Equipment
Section 15555 - Boilers
Section 15650 - Refrigeration
Section 15750 - Heat Transfer
Section 15880 – Air Distribution
Section 15900 - Ductwork and Accessories

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
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
Air Separators
Blowdown Discharge Piping
Flue Gas Breeching and Single Wall Stacks
Stacks to Roof
Boiler and Flue Boxes

3. 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 15240):
   Outside Air
   Mixed Air
   Medium Pressure Supply Air
   Low Pressure Supply Air
   Return Air
   Rigid Round Runouts to Diffusers

4. Other Systems:

   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:

CertainTeed
Manson (Alley-K)
Owens-Corning
Johns Manville
Armstrong
Knauf
Dow Chemical
3M/Thermal Ceramics (FireMaster)
Unifrax (Fyrewrap)
SpecSeal (Claymac)
Renler (Pyroscat FastR Wrap)

2.2 MATERIALS

A. Conductivity:

TYPE OF INSULATION	MAXIMUM THERMAL CONDUCTIVITY/INCH
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

B. Duct Board: Rigid glass fiber board with a minimum density of 1-1/2 pounds per cubic foot, a maximum thermal conductivity of 0.24 at 75 deg.F and complying with National Fire Protection Association Pamphlet 90A.

C. Duct Wrap: Blanket-type fiberglass insulation 1-1/2" thick, 0.75 pounds per cubic foot density.

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.

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:

2003 International Energy Conservation Code

PIPE INSULATION THICKNESS IN INCHES*		
	Nominal Pipe Diameter	
Fluid	≤ 1.5"	> 1.5"
Hot Water	1.0	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 2003 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 specifiations.
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:

Horizontal piping and where freeze protection is required, one-half inch thick fiberglass pipe covering with all service jacket self-seal lap.

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 roof 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 15250-3.2, A.

4. Chilled Drinking Water:

Thicknesses per Chilled Water Piping System, 40-55 deg. F., of 15250-3.2 A.

5. Fittings:

Premolded PVC fitting covers with Fiberglass insert. PVC covers shall be rated for return air plenum use.

6. 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 15250-3.2, 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:

d. 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. 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 15240 – Mechanical Sound and Vibration Control for requirements for lined ductwork.

E. 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. 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.

END OF SECTION 15250

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15300 - 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. Interior and Exterior above Ground Piping.

E. Sprinkler System.

F. Fire Department Connections.

G. 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 15010 - Basic Mechanical Requirements.

C. The 15300 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 15050 - Basic Mechanical Materials and Methods.

B. Section 15240 - Mechanical Sound and Vibration Control.

C. Section 15410 - Plumbing Piping: Copper water piping.

D. Section 15411 - Disinfecting Water Supply System.

E. Section 15430 - Plumbing Specialties: Pressure gauges, air gap fittings, pressure relief valves.

F. Section 15487 - Fuel Oil System.

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 Division 1300 Contractor. Division 15300 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 15300 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 15300 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 15300 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 dry-pipe sprinkler system to protect the and similar areas subject to freezing.
2. Provide a freeze-protected sprinkler system using dry sprinkler heads or charged with U.S.P. glycerin or propylene glycol to protect vestibules, and similar areas subject to freezing.
3. Provide a wet pipe sprinkler system to protect all other areas of the building. Include protection of elevator shafts, furnace rooms, boiler rooms, and similar areas as required by code.
4. Provide inspector test valve and piped drain at each riser.

B. 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.

C. 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.

D. 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 15300 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.

E. System shall be hydraulically calculated per Jurisdictional Agency Standards.

F. 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.

G. 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.

H. Be responsible for accurate measurements, coordination with other trades, required offsets, scheduling, timely submittals, material delivery, job manning, and conformance to construction schedules.

I. Provide backflow protection in accordance with jurisdictional requirements. Provide back flow preventers of required types, and installed in an approved manner above grade. Backflow devices in pits or vaults below ground will not be acceptable. 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 15050 and 15430 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.

J. 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.

K. 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.

L. 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.

M. 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.

N. 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

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 - 1999 Edition.
   b. "National Electrical Code", NFPA 70 - 1999 Edition.
   c. "National Fire Alarm Code", NFPA 72 - 1996 Edition.
   d. "Inspection, Maintenance and Testing of Water- Based Suppression Systems", NFPA 25 - 1995 Edition.

2. All building construction work shall conform to the 2003 International Building Code and 2003 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 local Fire Department. Acceptance of the completed systems by the local Fire Department 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 2004, 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. 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, one (1) set of reproducible record drawings 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.

1.11 WARRANTIES

A. Provide original copies of all warranties and extended warranties for specific equipment where specified and in accordance with Section 15010.

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. Backflow Preventer: Provide backflow preventer above ground heat traced with self regulating cable, in accordance with Section 15050.

1. Double check assembly, U.L. Classified, FM Approved, with shut-off valves. Febco 805Y, or approved equal.

D. Thrust Blocks - Tie Rods:

1. 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.
2. 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.

E. Cathodic Protection:

1. Provide 8 mil thick minimum polyethylene pipe wrap, overlap at joints and seal joint with 2" wide minimum polyethylene tape triple wrapped and extending at least 6" both ways beyond joint seam or provide machine wrapped scotchwrap #51 PVC tape with 50% overlap wrap on pipe primed with scotchwrap primer. Double wrap all fittings to 6" beyond fitting onto pipe. Provide primer on fittings, bolts, and nuts prior to wrapping.

2.3 FIRE HYDRANTS

A. Provide hydrants of 3-way pattern with two 2-1/2" hose nozzles, one 4-1/2" pumper nozzle, 5-1/4" nominal main valve pening, MJ inlet connection. Opening direction, operating nut, and nozzle threading shall conform with local jurisdictional regulations. Verify these items prior to order and installation. Bury depth to be below local frost/freeze depth. Hydrant to be dry top-traffic pattern and painted (color coded) per local standards. Hydrants U.L.-FM approved where applicable.

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. Light wall conforming to ASTM A-135 or ASTM A-795. 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 15050.
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. Valves:

1. All valves are to be indicating type.
2. All valves U.L. listed, F.M. approved.
3. Refer to Section 15050 for valve specifications.

D. 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, 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.

LOCATION	ORIENTATION	HEAD FINISH	COVER OR ESCUTCHEON
Office	Recessed	Chrome	White
Conference Rooms	Recessed	Chrome	White
Elevator Lobbies	Recessed	Chrome	Chrome
Entry Lobby	Concealed	Brass	White
Storage	Recessed	Brass	Chrome
Corridors	Recessed	Brass	White
Open Areas (No Ceilings)	Upright/Pendant	Brass	-
Equipment Rooms	Upright/Pendant	Brass	Chrome
Garage	Upright/Pendant	Brass	-

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.

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.
2. Pressure Switch for dry, deluge, alarm, and pre-action valves, U.L. Listed, 10 amp, 120v AC, dual contacts. Potter Model PS40A, 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.

I. Alarm Valves, Wet Pipe System: U.L. Listed, alarm check valve. Central Model F & G, or approved equal.

1. Provide with pressure switch variable pressure trim with retard and closed retard drain for use with pressure switch as required.

J. Dry Pipe Valve: U.L. Listed, control valve. Central Model AF & AG, or approved equal.

1. Provide as required, complete with all trim and drain extensions, for use with pressure switch as indicated.
2. Accelerator: U.L. Listed, complete with trim. Central Model B, or approved equal.
3. Air Maintenance Device: Provide automatic air maintenance device for dry pipe valves . Provide all trim, switches, strainers, valves for complete functional unit.

2.6 FIRE DEPARTMENT CONNECTION - INLET (SIAMESE)

A. Cast brass, single clapper, straight or angle style as indicated. Provide siamese connections of sizes, styles and patterns required, caps and chains, and wall plate.

B. Style: Flush.

C. Finish: Cast Brass.

2.7 WALL HYDRANT CONNECTION - OUTLET

A. Cast Brass, flush type. Provide wall hydrant outlets of sizes, styles, and pattern required with inlet control valve and valve access.

B. Finish: Cast Brass.

C. Provide Index Plates "Wall Hydrant" - "Wall Hydrant Control Valve" as required.

2.8 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.

2.9 AIR COMPRESSOR

A. Acceptable Manufacturers: Quincy, Ingersoll-Rand, Grinnell or equal.

B. Provide an automatic belt driven air compressor complete with 30 gallon minimum receiver, auto receiver drain, air cooled after cooler, belt guard, auto start stop - H.O.A., starter, panel, relief valve, pressure reducing valve in conformance with NFPA-13.

C. The air compressor shall be of sufficient horsepower and free air output to provide restoration of the total pipe volume in the system in 20 minutes or less.

D. Air compressor shall be a two stage reciprocating type mounted on a horizontal or vertical receiver and shall not be less than 1 HP. Voltage and phase shall be verified and motors furnished for proper electrical characteristics.

E. Provide a low pressure trouble alarm (NCO Bell) with sensor on inlet side of P.R.V. (between P.R.V. and receiver) set at 10 psig above required system maintenance pressure.

F. Provide air maintenance assembly.

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 15050 - 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 16 Contractor if desired by the Section 15300 Contractor but the Section 15300 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 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 15300

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15410 - 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 15010 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 15050 - Basic Mechanical Materials and Methods.

B. Section 15240 - Mechanical Sound and Vibration Control.

C. Section 15241 - Mechanical Seismic Control.

D. Section 15250 - Mechanical Insulation.

E. Section 15411 - Disinfecting Water Supply System.

F. Section 15430 - Plumbing Specialties.

G. Section 15450 – 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.\

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.

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.

4. Polyvinylchloride Water Pipe, Fittings, and Joints:

a. Rigid polyvinylchloride (PVC) pipe for potable water systems shall conform with NSF Standards #14 and #61. NSF pw logo shall be affixed (printed or molded) on all pipe fittings and joining materials. Materials shall meet requirements of cell classification 12454-A or -B per ASTM D-1784.
b. Pipe to be IPS size conforming to ASTM D 2241, be provided with integral bell end steel reinforced gasket and comply with ASTM D 3139.
c. Pipe markings shall include nominal and O.D. base sizes, PVC 1120, DR 21, AWWA pressure class 200, ASTM D 2241, manufacturer name or trademark, production code, and NSF seal, AWWA C-900, UL as appropriate.
d. Certified 800 psi test, in accordance with AWWA loading criteria, must be furnished to the Engineer for supplied pipe.

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 made with 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. 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 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.

   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 ABI BEST couplings may be used in lieu of hub and spigot with Ty-Seal neoprene gaskets. The couplings shall have ASTM C564 neoprene gaskets, 0.008" stainless steel shields with transverse corrugations across longitudinal corrugations, standard 304 stainless steel clamps and 305 stainless steel screws. Entire assembly shall accommodate 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 couplings with restrained joints horizontal and vertical up to 80 psig. 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. Copper Waste, Vent and Soil Pipe and Fittings shall be prohibited on this project.

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 15050.

3.2 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. Screwed pipe - Screwed pipe (IPS), shall be supported in accordance with Section 15050.
    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. Vandal proof vent caps shall be installed on all sanitary vents extending through roofs.
16. Provide all expansion joints, braces, earthquake restraints as required by the contract documents (Section 15241) and jurisdictional authority.

3.3 PROHIBITED PIPE ROUTING

A. Plumbing piping, regardless of contents (water, sewer, vent, etc.) shall not 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.

3.4 COMPRESSED AIR

A. Provide compressed air piping pitched to low points at 1" per 40 ft (min.) with drain valve at all low points. All branch line takeoffs from CA main shall be made from top of main.

B. Provide filters and separators for all spray paint supply branches.

C. Provide lubricators and filters for all pneumatic hand tools requiring lubrication.

D. Provide ball valves for all main line and branch shut-offs.

E. Provide all gauges, accessories and connectors required to match new or existing system and components.

F. Provide quick disconnect fittings compatible with owner's equipment at each branch line termination. Terminations shall be at 4 ft. A.F.F. unless noted otherwise.

3.5 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-
3. Compressed Air:							
Single Stage Compressor		X	X		100	30	+ 1/2
Two Stage Compressor		X	X		200	30	+ 1/2
4. Distilled and Deionized			X		60	30	-0-

B. Testing connections for hydrostatic tests shall be made at the base of the system. Compressed air 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 15410

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15411 - 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 15010 - Basic Mechanical Requirements.

C. Section 15410 - 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 15010:

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 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.

3.2 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 15411

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SECTION 15430 - 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. Trap chargers and accessories.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish electrical outlets installed in Washer Wall Box for Division 16 power wiring installation.

1.3 RELATED WORK•

A. Requirements: Provide Plumbing Specialties in accordance with the Contract Documents.

B. Section 15010 - Basic Mechanical Requirements.

C. Section 15050 - 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. Sillcocks (SC), Ground Hydrants (GH) and Yard Hydrants (YH)
2. Hose Bibbs
3. Backflow Preventer (BP)
4. Pressure Reducing Valve (PRV)

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 15010:

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 15010.

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:

Plan Code	FD-1	FD-1
Typical Use	Note 2	Note 2
Style	Round	Round
Material	Cast Iron	Cast Iron
Pipe Size	2" - 3"	4"
Top Size	5" min.	7" min.
Strainer	Nickel Bronze	Nickel Bronze
Vandal Proof Security Screws	Yes	Yes
Sediment Bucket	No	No
Seepage Flange	Yes	Yes
Flashing Clamp	Note 1	Note 1
Trap Primer Fitting	Where Required	Where Required
Funnel	No	No
Deep Seal (4") Trap	Yes	Yes

Note 1: Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.

Note 2: Finished areas, showers, toilets, etc.

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 F1340C.

B. Schedule:

Plan Code	FD-2
Typical Use	Note 2
Style	Round
Material	Cast Iron
Pipe Size	2" - 8"
Top Size	12"
Strainer	Ductile Iron or Cast Iron
Vandal Proof Security Screws	No
Sediment Bucket	Yes
Seepage Flange	Yes
Flashing Clamp	Note 1
Trap Primer Fitting	Where Required
Funnel	No
Deep Seal (4") Trap	Yes

Note 1: Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.
Note 2: Mechanical equipment rooms, shops, etc.

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 FS-710/740 series, MIFAB series FS1520/FS1730.

B. Schedule:

Plan Code	FS-1	FS-2	FS-3
Typical Use	Note 3	Note 4	Note 5
Style	Square	Square	Square
Size	12"x12"8"D	12"x12"x8"D	8"x8"x6"D
Material	Cast Iron	Cast Iron	Cast Iron
Finish	Enamel Interior	Enamel Interior	Enamel Interior
Grate	Note 1 Nickel Bronze	Note 1 Cast Iron	Note 1 Nickel Bronze
Dome Strainer	Yes	No	Yes
Sediment Bucket	No	Yes	No
Seepage Flange	Yes	Yes	Yes
Flashing Clamp	Note 2	Note 2	Note 2
Vandal Resistant Security Screws	Yes	No	No
Trap Primer Fitting	No	No	Yes
Funnel	No	No	No

Note 1: Provide full grate unless otherwise noted, provide 1/2 or 3/4 grate where indicated on Drawings.

Note 2: Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.

Note 3: Indirect waste for kitchen, laundry, etc.

Note 4: Indirect waste and floor drainage for mechanical equipment rooms.

Note 5: Indirect waste for icemakers, sterilizers, etc.

2.5 GARAGE DRAINS (GD)

A. Acceptable Manufacturers: Wade series 1210, JR Smith series 2230, Josam series 32320, Zurn series Z-541, Watts FD-340-Y series, MIFAB series F-1340.

B. Schedule:

Plan Code	GD-1
Style	Round
Material	Cast Iron
Pipe Size	2"-8"
Top Size	12"
Grate	Ductile Iron
Load Class	5,000 - 7,500 lb.
Vandal Proof Security Screws	No
Sediment Bucket	Yes
Seepage Flange	Yes
Flashing Clamp	Yes
Deck Clamp	Yes
Sediment Bucket	Yes

2.6 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:

Plan Code	RD-1	RD-2
Material	Cast Iron	Cast Iron
Size	15" nom.	8" nom.
Dome	Poly Aluminum	Poly Aluminum
Flashing Clamp	Yes	Yes
Deck Clamp	Yes	Yes

Plan Code	RD-1	RD-2
Bearing Pan/Receiver	Yes	Yes
Vandal Proof Security Screws	Yes	Yes
Adjustable Extension	No	No
Extended Perforated Gravel Stop	Yes	Yes
Pipe Size	2"-10"	2"-4"

2.7 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:

Plan Code	OD-1	OD-2
Material	Cast Iron	Cast Iron
Size	15" nom.	8" nom.
Dome	Poly Aluminum	Poly Aluminum
Flashing Clamp	Yes	Yes
Deck Clamp	Yes	Yes
Bearing Pan/Receiver	Yes	Yes
Vandal Proof Security Screws	Yes	Yes
Stand Pipe	Note 1	Note 1
Extended Perforated Gravel Stop	Yes	Yes
Dam	Note 1	Note 1

Note 1: Provide overflow drains with 2" high stand pipe or dam as appropriate for the style of drain furnished.

2.8 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:

Plan Code	DSN
Material	Nickel Bronze
Wall Flange	Yes
Size	2"-8"

2.9 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.

B. Schedule:

Plan Code	EJ
Material	Cast Iron
Sleeve	Bronze/Brass
Gasket	Neoprene or Graphite
Size	2"-10"

2.10 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:

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, and similar unfinished areas.

2.11 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, stainless steel cover with screw.

2.12 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.

2.13 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. Cast iron body and dome, vandal proof screws.

2.14 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.

2.15 WATER HEATER SAFETY PAN (WHSP)

A. Provide Shamrock Industries Inc. or equivalent gray polyethylene pan 2" larger than heater diameter with side or bottom drain fitting as required by drawings on electric water heaters installed above ceilings, under counters or on wood flooring.

B. Provide Ruud Mfg. Co. "Heater Pan" or equivalent spun aluminum pan with side or bottom drain fitting as required by drawings on gas fired water heaters installed on combustible foundations with 3/4" thick fire proof liner between pan and combustible construction.

2.16 SILLCOCK, EXPOSED, NON-FREEZE

A. Acceptable manufacturers: Woodford series 65, JR Smith series 5609, Josam series 71200, Zurn series Z-1310, Wade series 8600, Watts HY-420 series.

B. Schedule:

Plan Code	SC-1
Freeze Proof	Yes
Vacuum Breaker	Yes
Material	Brass
Finish	Rough Brass
Outlet	¾" Hose Thread
Operator	Loose Key
Wall Clamp	Yes

2.17 SILLCOCK, EXPOSED, MILD CLIMATE

A. Acceptable manufacturers: Woodford series 74, JR Smith series 5607, Josam series 71220, Zurn series Z-1333, Watts HY-430 series.

B. Schedule:

Plan Code	SC-2
Freeze Proof	No
Vacuum Breaker	Yes
Material	Brass
Finish	Rough Brass
Outlet	¾" Hose Thread
Operator	Loose Key
Wall Clamp	No

2.18 SILLCOCK, WALL BOX, NON-FREEZE

A. Acceptable manufacturers: Woodford series B65, JR Smith series 5509, Josam series 71150, Zurn series Z-1300, Wade series 8600,175, Watts HY-725 series.

B. Schedule:

Plan Code	SC-4
Freeze Proof	Yes
Vacuum Breaker	Yes
Material	Brass/Bronze
Finish	Polished Brass
Outlet	¾" Hose Thread
Operator	Loose Key
Lockable Wall Box	Yes

2.19 HOSE BIBBS

A. Acceptable manufacturers: As listed in schedule.

B. Schedule:

Plan Code	HB-1	HB-2	HB-3
Typical use	Note 1	Note 2	Note 3
Material	Brass	Brass	Brass
Finish	Polished Chrome	Polished Chrome	Rough Brass
Vacuum Breaker	Yes	Yes	Yes
Outlet	3/4" Hose Thread	3/4" Hose Thread	3/4" Hose Thread
Operator	Loose Key	Lever or Tee	Tee or Wheel
Wall Flange	Yes	Yes	Yes
Chicago Faucet	No. 952	No. 13	No. 13T
Woodford	-----	24 P	24
T & S Brass	B-720	B736-POL	-----

Note 1: Toilet rooms, Janitor's mop station, etc.

Note 2: Finished areas.

Note 3: Equipment rooms, unfinished areas.

2.20 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. Compressed Air 0 to +160 psi
3. Pump Gauges -30 in Hg to +100 psi

2.21 STATIONARY THERMOMETERS

A. Acceptable manufacturers: Trerice Industrial Series, Ametek Industrial Series, Weiss Instruments, Miljoco.

B. Schedule:

Plan code:	T-1	T-2
Type	Adjustable angle	Rigid
Case	9" cast aluminum	9" cast aluminum
Window	Clear acrylic	Clear acrylic
Tube	Red mercury	Red mercury
Stem	Aluminum, insertable	Aluminum, insertable
Separable Socket	Brass	Brass

C. Range: Select thermometers, for the following standard ranges unless otherwise indicated on Drawings, or as required for special systems.

1. Heating water 30 to 240 °F
2. Domestic cold water 0 to 100 °F
3. Domestic hot water 30 to 240 °F

2.22 TEMPERATURE AND PRESSURE TEST PLUGS (T&PTP)

A. Manufacturer: Trerice, Fairfax, Flow Design, Peterson Equipment (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 D3752 (0-300 psig)

2.23 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

2.24 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.

2.25 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.

2.26 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 MAXIMUM
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

2.27 TRAP CHARGERS AND ACCESSORIES (TP-1)

A. Manufacturer: Precision Plumbing Products, Co. ("P.P.P.")

B. Schedule:

MODEL	DISTRIBUTION UNIT	SUPPLY TUBE
P-2	1 thru 4 outlets per unit as shown on drawings.	Y

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 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.

3.3 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.

3.4 CLEANOUTS

A. Provide cleanouts at 50 feet on center for all interior sanitary and storm piping, 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.

3.5 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.

B. Install safety pans for all gas fired water heaters installed on combustible foundations.

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.

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.

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.

END OF SECTION 15430

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SECTION 15440 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plumbing Fixtures and Trim.

B. Plumbing Fixture Accessories.

1.2 PRODUCTS INSTALLED BUT FURNISHED UNDER OTHER SECTIONS

A. Section 11600 - Laboratory Equipment: Laboratory fixtures, trim and equipment.

B. Section 11400 - Food Service Equipment: Kitchen fixtures, trim and equipment.

C. Section 11470 - Darkroom Equipment: Darkroom sinks and trim.

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 15010 - Basic Mechanical Requirements.

1.4 RELATED SECTIONS

A. Section 15050 - Basic Mechanical Materials and Methods.

B. Section 15410 - Plumbing Piping.

C. Section 15430 - Plumbing Specialties.

D. Section 15450 – Plumbing Equipment.

E. Section 15460 - Special Plumbing Equipment Systems.

1.5 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.

1.6 SYSTEM DESCRIPTION

A. Provide all plumbing fixtures, materials, labor, accurate rough-in setting, leveling and adjustments of all fixtures, trim and specialties.

1.7 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.

1.8 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Fixtures.
2. Faucets, showerheads, valves, cocks, supplies and stops.
3. Finishes, material and colors.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 15010:

1. Valves, faucets, cocks.
2. Plumbing fixtures.
3. Specialties.

1.9 WARRANTIES

A. Provide original copies of all warranties and extended warranties for specific equipment where specified and in accordance with Section 15010.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cast iron and vitreous china: Kohler - Eljer - American Standard - Crane.

B. Stainless steel sink 304, 18 gauge minimum: Elkay - Just.

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.

F. Electric Water Coolers: Elkay - Halsey Taylor - Cordley - Haws - Sunroc - Filtrine - Oasis.

G. Water Mixing Valves – Thermostatic (no Pressure Balanced): Leonard - Symmons - Lawler.

H. Metering Faucets: Bradley - Symmons – Speakman - Zurn.

I. Flush Valves: Sloan Royal - Delany Flushboy – Zurn - AquaVantage.

J. Toilet Seats: Olsonite - Beneke - Sperzel- Bemis - Church.

K. Traps, Stops, Supplies, Airgaps, Drains: Kohler - Eljer - American Standard - Bridgeport - Brasscraft - Dearborn - Sayco - Frost - Eastman.

L. Chair Carriers: Josam - J.R. Smith - Zurn - Wade.

M. Faucets: Kohler - Eljer - American Standard - Bradley - Valley - Elkay - Chicago - Delta - Cambridge Brass.

N. Kitchen Equipment Trim: Fisher - Chicago Faucet - T & S Brass - Cambridge Brass.

2.2 WATER CLOSETS

A. Floor Set, Siphon Jet, Valve Operated, Water Saver, 12" rough with open front seat:

Plan Code:	WC-1	WC-2
Make:	Kohler	Kohler
Model:	K-4450-C	K-4450-C
Seat Make:	Bemis	Bemis
Model:	1955C	1955C
Bolt Caps: (Typ. of 2)	K-4562	K-4562
Color:	White	White
Set, Floor to Rim:	15"	17"
Flush Valve Make:	Zurn	Zurn
Style:		
Model:	Z-6000-WS1	Z-6000-WS1

2.3 LAVATORIES

A. Counter Top Mounted Oval:

Plan Code:	L-1
Make:	Kohler
Model:	K-2196
Style:	Self-Rimming
Size:	20-1/4" x 17-1/4" Dia.
Hole Drilling:	3 @ 4" OC
Trap:	K-9000 1-1/4"
Faucets	
2 Valve Std.:	K-7443-T

2.4 URINALS

A. Wall Hung, Carrier Mounted, Valve Operated Siphon Jet:

Plan Code:	U-1
Make:	Kohler
Model:	K-4989-T
Style:	1-1/4" Top Spud
Set Floor to Rim (STD):	U-24"
Set Floor to Rim (HDCP):	U-17"
Flush Valve	
Make:	Zurn
Style:	
Model:	Z-6003-WS1
Supply:	1"
Carrier	
Make:	Wade
Model:	W400

2.5 SERVICE SINKS

A. Enameled Cast Iron:

Plan Code:	SS-1	SS-
Make:	Kohler	
Style:	Whitby	
Model:	K-6710	
Faucet:	K-8928	
Guard:	K-8936	
Material:	Enameled Cast Iron	Enameled Cast Iron

2.6 ELECTRIC WATER COOLERS

A. Wall Hung, Carrier Mounted, Wheelchair:

Plan Code:	EWC-1	EWC-
Make:	Oasis	
Style:	Wheelchair	
Model:	P8AMSL	
GPH:	8.0	
Cabinet Finish:	SS	
Amps MAx.:	4.6	
Compressor HP Max.:	1/4	
Carrier		
Make:	Wade	
Model:	W400AM11	
Set-Floor to Spout:	34 1/2"	

2.7 SINKS

A. Stainless Steel, Self Rim:

Plan Code:	S-1	S-
Make:	Elkay	
Model:	LR-3322	
Compartments:	2	
Gauge Min.:	18	
S.S. Type Min.:	302	
Faucet Hole Punch:	3	
Faucet Make:	Elkay	
Model:	LK-232-S-BH-5	
Strainer:	LK-35B	
Trap:	17 ga. with C.O., 1-1/2" for sink, 2" for disposer separate traps each compartment.	
Sink Size O.A.:	33"x22"x8"	

2.8 SHOWERS

A. Individual Concealed Thermostatic Valve and Head (Stall provided under Architectural Divisions of the Work):

Plan Code:	SH-1
Valve Make:	Leonard
Model:	LVC-FS
Head:	31SA

2.9 LAVATORY THERMOSTATIC MIXING VALVES

A. Adjustable high temperature limit stop (factory set for 110°F), thermostatic type, inlet check stops. Provide recessed locking stainless steel cabinet where indicated.

Plan Code:	MV-1
Valve Make:	Leonard
Model:	210-SB

B. Alternate Model: Symmons Series 5.

2.10 FIXTURE SUPPLIES & STOPS

A. Schedule:

DF & 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

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. Wall Mounted

a. Closet carriers are to be rigidly anchored to the floor structure in accordance with manufactures installation instructions.
b. Wall mounted water closets will be rigidly supported with brass mounting studs on a concealed metal carrier. Transmitting fixture weight loads to the fixture pipe connection or wall framing will not be acceptable.
c. Water closets and trim shall be set level and plumb.
d. Spacing of water closets shall be in accordance with contract documents and jurisdictional codes.
e. 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. Concealed arm carriers will not be acceptable.
c. Wall mounted lavatories are to be supported by concealed metal carriers. Transmitting fixture weight loads to the fixture pipe connection is not acceptable.
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. Electric Water Cooler:

1. Wall Mounted

a. Electric water cooler carriers are to be rigidly anchored to the floor structure in accordance with manufacturers 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.

2. Fully Recessed

a. Fully recessed electric water coolers shall be furnished with wall mounting boxes anchored to building construction. Electric water coolers shall be mounted flush to finished wall.

F. 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.

G. 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 15430.
c. The shower drain grate area shall be not less then 1-1/2 times the free area of the waste pipe.

H. Master 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.

I. Pressure Balance Type Shower Valves:

1. Adjust limit stop control to 110 degrees F maximum temperature. Failure to adjust this control properly may result in serious scalding.

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 15 contractor in accordance with Section 15050.

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)				
Lavatory (L):	½"	½"	1-1/4"	1-1/4"
Urinal (U):				
Flush Valve:	NA	3/4"	2"	1-1/2"
Service Sinks (SS):	½"	½"	3"	1-1/2"
Sink (S):	½"	½"	1-1/2"	1-1/2"
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.

END OF SECTION 15440

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SECTION 15450 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Water Heaters and Accessories

B. Specialty Pumps

1.2 RELATED WORK

A. Requirements: Provide Plumbing Equipment in accordance with the Contract Documents.

B. Section 15010 - Basic Mechanical Requirements.

C. Section 15050 - Basic Mechanical Materials and Methods.

D. Section 15240 - Mechanical Sound and Vibration Control.

E. Section 15241 - Mechanical Seismic Control.

F. Section 15410 - Plumbing Piping.

G. Section 15430 - Plumbing Specialties.

H. Section 15485 - Natural Gas Systems.

I. Section 15575 - Breechings, Chimneys, Stacks and Flues.

1.3 SUBMITTALS

A. Submit product specification data for the following items under provision of The General Conditions of the Contract:

1. Water Heaters, Accessories and Controls.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 15010:

1. Pumps.

1.4 WARRANTIES

A. Provide original warranties for specific equipment of term specified and in accordance with Section 15010.

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 GAS FIRED STORAGE TYPE WATER HEATERS AND ACCESSORIES

A. Acceptable Manufacturers: A.O. Smith, Hatco, Lochinvar, P.V.I. Industries, Ruud, State Industries, Bradford White.

B. Description and Schedule:

1. Provide glass lined tank rated for 150 psi, 300 psi test, AGA Certified, and in conformance with Applicable Energy Code.
2. Provide ASME certified pressure and temperature relief valve, power burner, 100% pilot and main burner safety shut off, electronic spark ignition.
3. Provide corrosion resistant enameled steel jacket, blanket or approved foam insulation with minimum insulation factor of R=16, Dielectric Unions for water connections, heavy magnesium anode rod, drain valve, combustion chamber access and manhole as applicable.
4. Schedule:

Drawing Code:	WH-1
Make:	AO Smith
Model:	BTH-300
Storage (Gallons):	130
BTUH Input:	299,000
Recovery at 100 deg.F Rise:	257
Vent Size (inches dia.):	4"
Water Tapping Size (ips):	1-1/2"

5. Provide ten year warranty.
6. Burners shall be orificed for equivalent BTUH at altitude of, and calorific value of, gas at point of installation.

2.3 INSTANTANEOUS POINT OF USE ELECTRIC WATER HEATERS

A. Acceptable Manufacturers: International Technology Sales Corp. (trade name ITS), Chronomite Industries, Bradford White.

B. Warranty: 1 year full non-prorated for entire unit, including the element.

C. Schedule:

Drawing Code:	WH-1
Make:	Chronomite
Model:	S1-46
Flow Rate (GPM):	0.5
Temp Rise (deg.F):	63
Kilowatts:	4.6
Voltage	208
Hertz:	60
Phase:	1

D. Provide power cord; plug, mounting brackets, stops, and connection as required. Be responsible to coordinate with appropriate power supply receptacle provided by Division 16 Contractor.

2.4 DOMESTIC HOT WATER CIRCULATING PUMPS

A. Acceptable Manufacturers:

1. Taco
2. Bell and Gossett
3. Grundfos
4. Paco

B. Provide in-line type circulating pumps, all bronze construction, 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 single pole double throw pump operating switch for remote mounting as shown on drawings (One switch per pump).

PART 3 - EXECUTION

3.1 GAS FIRED STORAGE TYPE WATER HEATERS

A. Set level and plumb, adjust burners to proper flame, set temperature, and verify, to 135 deg.F minimum setting.

B. Provide an expansion tank on the hot water side of all water heaters.

C. Provide ASME temperature and pressure relief valve with full size discharge piped and air gapped to nearest floor drain or other acceptable receptacle.

D. Provide hose and drain valve, mixing valve, blending chamber, shut off valves and dielectric connections as required and appropriate.

E. Provide gas connection with gas valve, dirt leg and cap, pressure regulator and pilot control in accordance with Section 15485 – Natural Gas System.

F. Sealed combustion water heaters installed in a negative pressure room will require a ¼" vinyl hose run from the pressure switch to the outdoor atmosphere.

3.2 DOMESTIC HOT WATER CIRCULATING PUMPS

A. Coordinate wall mounted "on-off" toggle switch for pump and electrical power requirements with Division 16 Contractor in accordance with Section 15050 - 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.

END OF SECTION 15450

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SECTION 15485 - NATURAL GAS SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Fittings.

B. Gas Meter.

C. Gas Pressure Regulator.

D. Flexible Connectors and Quick Couplers.

E. Earthquake Shut-off Valve.

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 15010 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 15050- Basic Mechanical Materials and Methods: Valves, pipe hangers, supports and accessories.

B. Section 15241 - Mechanical Seismic Control.

C. Section 15450 - Plumbing Equipment: Gas supply and runout gas cock or valve to water heater connection points.

D. Section 15460 - 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 15555 - Boilers: Gas supply and runout with gas cock or valve to boiler connection points.

F. Section 15851 - 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. ANSI B31.2 - Fuel Gas Piping.

B. NFPA 54 (ANSI Z223.1) - National Fuel Gas Code.

C. 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 15050.

1.8 REGULATORY REQUIREMENTS

A. Conform to Regulatory Requirements listed in Section 15010.

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.
4. Earthquake Shut-off Valves.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 15010:

1. Regulators.
2. Meters.
3. Valves.
4. Quick Couplers.
5. Earthquake Shut-off Valves

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 15010.

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 Utility Company to provide gas service to indicated location with shut-off at terminus. Consult with Utility as to extent of its work, costs, fees and permits involved. 15485 Contractor shall pay such costs and fees; obtain permits.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. 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.

B. Interior concealed non accessible and air plenums:

All pipe and fittings shall be welded per sub-paragraph B2 above.

2.2 GAS METER

A. Gas Meter: Provide AGA listed turbine gas meters with aluminum cases, temperature compensated, with internal corrosion-resistant components; threaded ends for 2" and smaller, flanged ends for 2-1/2" and larger; for gas working pressures, 0.60 specific gravity, and volume flow indicated.

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 FLEXIBLE HOSE GAS CONNECTORS AND QUICK COUPLERS

A. Manufacturers:
Flexible Connector: Thermo-Tech Products Co. or approved equal.
Quick Coupler: Hansen Manufacturing Co. "Gas Mate" or approved equal.

B. Description:
Flexible Connector: Corrugated type 304 stainless steel flexible pipe with stainless steel braid and heavy flexible armor shield.

Quick Coupler: One way quick coupler with gas rating in cubic feet per hour equal to equivalent gas appliance rating.

2.5 EARTHQUAKE SHUT-OFF VALVE

A. Install a KOSO Model No. 313 automatic shut-off valve on the main gas line just before the gas service enters the building.

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 15050 - 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:

1. 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.
2. Install "Tee" fitting with bottom outlet fitted with full size 6" long nipple and capped, at bottom of pipe risers or drops.
3. Use dielectric unions where dissimilar metals are joined together.
4. Use Teflon joint seal on metal gas piping threads, make up with 3 threads showing.
5. Remove cutting and threading burrs before assembling piping.
6. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged.
7. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping, or equipment connections are completed.
8. Connections to all gas-fired equipment shall include a union per 2.1, A of this section downstream of the manual gas shut-off valve.

C. 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 15050 - Basic Mechanical Materials and Methods.

3.4 ROOF SUPPORTS AND ANCHORS

A. Provide Erico brand pipe pier supports spaced per Hanger Specifications in Section 15050 - 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 15050 - Basic Mechanical Materials and Methods.

3.6 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.

3.7 GAS SERVICE

A. Complete arrangements with Utility Company to provide gas service to indicated location with shut-off at terminus.

B. Extend service pipe from Utility's terminus to inside building wall, under Utility's direction.

C. Provide shut-off outside building where indicated, in adjustable gas service valve box, with cover set flush to finished grade.

3.8. 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 15050 - Basic Mechanical Materials and Methods.

C. Provide enclosures, bumper protection or other accessories which may be required.

3.9 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.

3.10 FLEXIBLE HOSE GAS CONNECTORS AND QUICK COUPLERS

A. Provide flexible stainless steel connectors with full size quick coupler for all kitchen and heavy movable gas appliance equipment.

B. Connectors shall be of lengths required to displace equipment for complete cleaning under and around gas appliance.

C. Provide lubricated plug valve at service connection on equipment branch and quick coupler at service end of flexible hose connector.

D. Provide union connection on appliance or on manifold end of hose connection.

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 15485

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15511 - 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 15010 - Basic Mechanical Requirements
Section 15050 - Basic Mechanical Materials and Methods
Section 15240 - Mechanical Sound and Vibration Control
Section 15241 - Mechanical Seismic Control
Section 15250 - Mechanical Insulation
Section 15540 - HVAC Pumps
Section 15555 - Boilers
Section 15855 – Air Handling Units with Coils
Section 15880 – Air Distribution
Section 15955 - Electronic Controls
Section 15990 - Testing, Adjusting and Balancing
Section 15995 - Commissioning of HVAC

C. Work installed but furnished under other Sections:

1. Pot Feeders furnished under Section 15548 - HVAC Water Treatment.
2. Flexible pipe connectors - Section 15240.
3. Flow switches in the boiler water piping.
4. Two-way automatic control valves.
5. Three-way automatic control valves.
6. 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. Relief Valves.
3. Expansion Tanks
4. Diaphragm - Type Compression Tanks.
5. Air Vents.
6. Air Separators.
7. Strainers
8. Pump Suction fittings.
9. Valves in accordance with Section 15050.
10. Pipe hangers and supports, saddles and shield in accordance with Section 15050.
11. Expansion joints, anchors and guides.

12. Mechanical sound and vibration control in accordance with Section 15240.
13. Installation of automatic control valves.
14. Flow measuring stations.
15. Tests.
16. Antifreeze glycol treatment and specialties.

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 Product Data for the following items under provisions of The General Conditions of the Contract.

1. Diaphragm-Type Compression Tanks.
2. Air Separators.
3. Strainers.
4. Flow Measuring Stations.
5. Backflow Preventer.
6. Pressure Regulating Valves.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 15010.

1. Air Separators.
2. Strainers.
3. Flow Indicators.
4. Flow Measuring Stations.
5. Flow Meters.
6. Balancing Valves.

7. Expansion Joints and Guides.
8. Backflow Preventer.
9. 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 15548.
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 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 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.

1.7 EXTRA STOCK

A. Glycol: Provide sufficient Inhibited Propylene Glycol to maintain specified concentrations in HVAC Piping Systems during one year warranty period.

1.8 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.

PART 2 - PRODUCTS

2.1 HEATING WATER, 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 A or 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 buttweld 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 150 1/16 inch full faced - punched.

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:

ANSI/ASME B16.23 cast brass and/or
ANSI/ASME B16.29 solder wrought copper

3. Joints:

ASTM B32, solder, Grade 95 TA.

2.2 HEATING WATER PIPING, BURIED

A. Steel Pipe: ASTM A53, Schedule 40, with black with double layer, half-lapped 10 mil polyethylene tape.

1. Fittings: ASTM A234, forged steel welding type with double layer, half-lapped 10 mil polyethylene tape.
2. Joints: ANSI/AWS D1.1, welded.
3. Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.

B. Copper Tubing: ASTM B88, Type K annealed.

1. Fittings: ANSI/ASME B16.29 wrought copper.
2. Joints: ANSI/AWS A5.8 BCuP silver braze.
3. Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.

2.3 HEATING WATER PIPING FOR GROOVED PIPE OPTION

A. General: At Contractor's option, heating water, condenser water and chilled water piping may be mechanical roll grooved pipe couplings, fittings and butterfly valves.

B. Acceptable Manufacturers: Victaulic, Gustin-Bacon, 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".
3. "Rigid" line fitting and valve joints to be Victaulic "Style S-07" Couplings with or Grade "E" gaskets and nuts and bolts.
4. Joints designated Outlet Couplings to be Victaulic "Style 72" with Grade "E" gaskets and nuts and bolts.
5. Joints designated Reducing Couplings to be Victaulic "Style 750" with Grade "E" gaskets and standard nuts and bolts.
6. Flanged components connections to be Victaulic "Style 741 Vic-Flanges" with Grade "E" gaskets.
7. Fittings: Fittings to be Victaulic "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 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.

2.4 STATIONARY PRESSURE GAUGES

A. Acceptable manufacturers: Trerice 600C series, Weksler Regal series, Weiss Instruments, Miljoco.

B. Schedule:

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. Compressed Air 0 to +160 psi
3. Pump Gauges -30 in Hg to +100 psi

2.5 STATIONARY THERMOMETERS

A. Acceptable manufacturers: Trerice Industrial Series, Ametek Industrial Series, Weiss Instruments, Miljoco, Weksler.

B. Schedule:

Plan Code:	T-1	T-2
Type	Adjustable angle	Rigid
Case	9" cast aluminum	9" cast aluminum
Window	Clear acrylic	Clear acrylic
Tube	Red mercury	Red mercury
Stem	Aluminum, insertable	Aluminum, insertable
Separable Socket	Brass	Brass

C. Range: Select thermometers, for the following standard ranges unless otherwise indicated on Drawings, or as required for special systems.

1.	Heating water	30 to 240 °F
2.	Domestic cold water	0 to 100 °F
3.	Domestic hot water	30 to 240 °F

2.6 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)

2.7 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. 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 ± 2" 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.

E. 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.

2.8 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.

2.9 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.

2.10 PUMP SUCTION FITTINGS

A. Acceptable Manufacturers: Bell and Gossett, Armstrong, Paco, Allis Chalmers, Weinman, Peerless, Aurora, Amtrol, Wheatley, Taco, Victaulic, Gustin-Bacon.

B. Pump suction fitting 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 section fitting to pump inlet.

E. Accessories: Adjustable foot supports, blowdown tapping in bottom, gauge tapping in side.

2.11 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.

2.12 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.

2.13 STRAINERS

A. Acceptable Manufacturers: Armstrong, Boylston, AW Cash, ITT, Hoffman, Keckley, Mueller, Trane, Metraflex, Victaulic, Gustin-Bacon, Conbraco.

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.

2.14 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Acceptable Manufacturers: Bell and Gossett, Amtrol, Wessels, Woods, Taco, Wheatley, Armstrong.

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 diaphragm sealed into tank, and steel legs or saddles.

D. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 20 psig.

2.15 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 petcock.

2.16 FLOW MEASURING SYSTEM

A. Acceptable Manufacturer: Griswold Corporation, Febco or approved equal.

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 "O" -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.

2.17 FLOW MEASURING STATIONS (VENTURI)

A. Furnish and install for each heating water, chilled water, and condenser water system and where shown on drawings, complete Barco Venturi Flow Measuring System as manufactured by Hyspan Barco, Flow Design, Febco or approved equal.

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 8" 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.

2.18 BALANCING VALVES (TERMINAL EQUIPMENT)

A. Acceptable Manufacturer: Bell & Gossett, Gerand, Armstrong, Taco, Amtrol, Tour & Andersson, Flow Design.

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.

2.19 GLYCOL FILL SYSTEM

A. Mixing Tank: 45-gallon poly drum with fittings suitable for filling, low level switch, and electric pump for charging. Pressure switch actuated controls with pre-wired control panel. Control panel shall include pump H-O-A switch and push button to silence low level alarm.

2.20 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.

C. Provide: In specified concentrations in HVAC Water Piping Systems listed in Part 3 of this Section 15511.

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 15050.

3.2 PIPE SLOPE

A. Slope all domestic water, heating 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.

3.4 SYSTEM PRESSURE SETTINGS

A. Hot Water Heating System: Set pressure reducing fill valve at 20 psig.

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 15955 - 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 15240 - 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 GAUGES FOR BOILER INSTALLATION

A. Contractor shall furnish and install a set of four adjustable, indicating type, mercury filled 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:

1. Heating water line entering boiler.
2. Heating water line leaving boiler.

B. Thermometer bulb shall project sufficiently into pipe to accurately measure water temperature. Cases shall clear insulation.

C. 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 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:

Heating Water System 25%

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

3.15 BACKFLOW PREVENTER

A. Provide on cold water make-up line to heating water piping systems. Locate on high pressure side of reducing valve on system water make-up line.

3.16 TESTS

A. General: Provide test pump, gauges, meters, other instruments, materials, and labor, in connection with tests.

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 (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.

3.17 CLEANING OF PIPING SYSTEMS

A. Provide for the cleaning of the HVAC Piping Systems after hydrostatic tests have been completed and prior to the operating tests in accordance with Section 15548 - HVAC Water Treatment.

3.18 WATER COUPON RACK

A. Install the water coupon rack in the condenser water system furnished by 15548 Contractor.

B. Pipe in parallel with the water system to be monitored in accordance with piping diagram and instructions provided by Section 15548 Contractor.

3.19 HVAC WATER TREATMENT

A. Provide valved tees and piping and 3/4 inch threadolets for water treatment apparatus in accordance with Section 15548 HVAC Water Treatment Contractor instructions.

END OF SECTION 15511

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15540 - 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 15010 - Basic Mechanical Requirements
Section 15050 - Basic Mechanical Materials and Methods
Section 15240 - Mechanical Sound and Vibration Control
Section 15250 - Mechanical Insulation
Section 15511 - HVAC Piping and Specialities
Section 15555 - Boilers
Section 15855 – Air Handling Units with Coils
Section 15955 - Electronic Controls
Section 15990 - Testing, Adjusting and Balancing
Section 15995 - Commissioning of HVAC

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to, providing the following:

1. Heating water system pumps.
2. Mechanical sound and vibration control in accordance with Section 15240.

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:

B. 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 as scheduled conditions and 120% of scheduled head, for the following items in accordance with the General Conditions of the Contract:

1. Heating 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 15010.

1. All pumps.

PART 2 - PRODUCTS

2.1 IN-LINE TYPE WATER PUMPS

A. Approved Manufacturers - Bell & Gossett, Armstrong Co., 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. Type - Pumps shall be selected for quiet operation. Pump curve shall be submitted for review, capacities and model number as shown on Drawings.

D. Motor to be non-overloading throughout the range of the pump curve and in accordance with "Motors" in Section 15050.

E. Pump Shaft - Shall be alloy steel, and shall have bronze sleeve-type bearings. Pump seal shall be of the mechanical type.

F. Motor: Shall be quiet operating type, 1750 RPM in accordance with "Motors" in Section 15050.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide installation in accordance with Section 15240 - 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 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.

END OF SECTION 15540

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15548 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Pre-Startup cleaning of HVAC Piping Systems.

B. Pre-Startup cleaning of Boilers.

C. Chemical Feeders.

D. Treatment for Closed Systems:

1. Heating Water

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish only the following items to Section 15511 - HVAC Piping Contractor for installation:

Manifolds
Pot Feeders
Complete instruction for corrosion coupon rack

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 15010 - Basic Mechanical Requirements.

C. Section 15050 - Basic Mechanical Materials and Methods.

D. Section 15411 - Disinfecting Water Supply System.

E. Section 15511 - 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:

1. Nalco
2. Hi-Valley Chemical
3. WEST, Inc.
4. Alpine Technical Services
5. Power Engineering Company

E. 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 15010.

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 15 Contractor at the startup of the system.
2. A bi-annual 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 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 15000 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 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.

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 STARTUP CLEANING OF STEAM PIPING SYSTEM

A. Provide chemicals for startup cleaning of steam and condensate piping systems. Assist installing contractor and boiler startup technician during boiler startup to conduct once-through cleaning of piping systems.

2.3 CHEMICAL FEED EQUIPMENT FOR CLOSED SYSTEMS

A. Provide pot feeders for the following closed systems:

1. Heating Water

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.

2.4 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 15511.

2.5 CORROSION COUPONS

A. Furnish complete instructions and piping details to the HVAC Piping Section 15511 Contractor to provide a complete Water Coupon Rack per ASTM #D2688 for heating water system.

B. Water Treatment Contractor shall furnish three corrosion coupons and coupon holders for coupon rack insert positions. Coupons shall be mild steel and copper. Water treatment Contractor shall weigh coupons after 90 days and replace with new ones. A report shall be submitted to the Owner <and Engineer> as to corrosion levels determined.

2.6 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate where installation of equipment in piping systems is required with the Section 15511 - HVAC Piping Contractor and Electrical requirements per Section 15050 - 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 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 15000 Contractor.

3.3 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 15 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 15548

Utah National Guard
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Riverton, Utah
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SECTION 15555 - 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 15010 - Basic Mechanical Requirements
Section 15050 - Basic Mechanical Materials and Methods
Section 15250 - Mechanical Insulation
Section 15540 - HVAC Pumps
Section 15955 - Electronic Controls
Section 15990 - Testing, Adjusting and Balancing
Section 15995 - Commissioning of HVAC

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.

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.

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 15010.

1. All boilers and associated equipment.

1.6 WARRANTY

A. Provide under provisions of Section 15010 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 GAS FIRED WATER BOILERS

A. Acceptable Manufacturers: Patterson-Kelley, Lochinvar, Teledyne Laars, Bradford White.

B. Boilers shall be condensing type, listed for use with Category IV venting.

C. Warranty, 5-year warranty on heat exchanger parts.

D. Heat exchanger shall be copper tube with integral fin, ASME stamped for 160 psi working pressure, national board listed. Stainless steel burner, AGA Certified.

E. Boiler shall comply with the energy efficiency requirements of the State Energy Code (ASHRAE 90.1) and comply with efficiency listed on plans.

F. Multi-stage or modulating controls shall include intermittent pilot ignition system with flame supervision, main gas valves, gas pressure regulators, main and pilot manual shut-off valves, redundant safety shut-off valve, automatic reset high limit, manual reset

ECO, control transformer and circuit breaker, ASME temperature and pressure relief valve.

G. Boiler shall be furnished with a forced draft, flame retention gas burner. Burner shall be complete with integral motor and blower for supplying sufficient combustion air with normal vent conditions. Burner shall meet the current requirements of the Utah Division of Air Quality for low NOx emissions.

G. The following controls and trim shall be furnished:

- Combination thermometer and pressure gauge
- Water temperature control operator
- High limit safety control
- Low water cutoff
- ASME safety relief valve(s)
- Automatic gas valve - operator
- Auxiliary gas safety shutoff valve
- Pilot solenoid valve
- Pilot ignition assembly
- Ignition transformer
- Main manual gas shutoff valve
- Pilot cock
- Pilot and main gas pressure regulators
- Air safety switch
- Electronic combustion safety control with UV sensor
- Alarm bell to indicate flame failure
- Modulating gas burner
- Low fire start gas burner controls
- Lead lag systems for two or more boilers

1. Hot water heating supply and boiler "lead-lag" control:

   a. The boilers shall operate at a constant temperature thru controls furnished with the boiler set at 180 deg.F supply water temperature.

2. Provide in the supply discharge of each boiler, a line size 2 position normally open control valve with an end switch and supply water temperature sensor in the common water heater which, through a sequencing controller (furnished with boilers) will sequentially open the respective boiler control valve and activate the boiler control panel as follows:

   a. Boiler No. 1 operates at low fire thru the boiler controls, to maintain system supply temperature. On a drop in the system supply temperature, the boiler goes to high fire. On a continued drop in system supply temperature the sequencing controller, thru a delayed timer in boiler, shall open valve and turn on boiler No. 2 in same sequence as boiler No. 1.
   b. On a continued drop in system supply temperature the same sequence occurs to boiler No. 3 & 4 as outlined for Boiler No. 1.

c. On a rise in system supply temperature the reverse sequence shall occur. The 2 position control valves and control wiring between boiler will be by Section 15950 Contractor.

d. Valves to be wired in a manner which allows for "lead-lag" selection of boilers. Valve on lead boiler must be open at all times. Boiler Manufacturer to coordinate proper wiring sequence with Section 15950 Contractor.

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 CO2 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 15 Contractor familiar with the system shall also be present and witness this test.

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 multi-temp 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 15575 - 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. Boilers shall be vented in accordance with Section 15575 - 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 15 Contractor. All wiring to be heat and moisture resistant, minimum 105 deg.C.

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 15555

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SECTION 15575 - BREECHINGS, CHIMNEYS, STACKS, AND FLUES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Type B Flue Vents.

B. Positive Pressure Condensing (Category IV) Chimney and Manifold System.

1.2 RELATED WORK

A. Requirements: Provide Breechings, Chimneys, Stacks and Flues in accordance with the Contract Documents.

B. Section 15010 - Basic Mechanical Requirements.

C. Section 15050 - Basic Mechanical Materials and Methods.

D. Section 15450 - Plumbing Equipment.

E. Section 15555 - Boilers.

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 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. Category IV Positive Pressure Chimney and Manifold System.
2. Type B Flue Vents.

B. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Type B Flue Vents.
2. Category IV Positive Pressure Chimney and Manifold System.

PART 2 - PRODUCTS

2.1 TYPE B FLUE VENTS

A. Acceptable Manufacturers:

Selkirk Metalbestos
Simpson Dura-Vent
Ameri-Vent, American Metal Products Co.
United McGill
Metal-Fab

B. General: Provide double wall gas vents, UL-listed for Type B, consisting of double wall metal construction pipe sections and fittings and accessories required for complete installation.

C. Material: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel.

D. Accessories: Provide manufacturer's standard accessory items including draft hood connectors, tees, caps, elbows, increasers, adaptors, support plates, thimbles, storm collars, roof flashings and vent tops as indicated and required for complete installation.

2.2 POSITIVE PRESSURE CONDENSING (CATEGORY IV) CHIMNEY AND MANIFOLD SYSTEM

A. Acceptable Manufacturer:

Selkirk Metalbestos Model PS
Schebler

B. Other acceptable manufacturers offering equivalent products:

United McGill Unistack, Metal-Fab PIC, Ampco VSI, Van Packer DW

C. General: Provide double wall metal chimney, U.L. Listed for use with building heating equipment burning gas, solid or liquid fuels as described in NFPA 211, Section 2-3.1 and Appendix A.

D. Material: Double wall metal chimney with outer jacket of aluminum coated steel with minimum one inch air space between the walls and inner gas-carrying pipe of Type 304 stainless steel.

E. Accessories: Provide manufacturer's standard accessory items including flanged boiler kits, clamp flanges, elbows, increasers, tees, wyes, drain sections, wall supports, wall guides, floor guides, plate supports, roof supports, ventilated roof thimbles, flashings,

storm collars, exit cones, open stack top rings and stack caps as indicated and required for complete installation.

F. Seals: For flue gas temperatures up to 600 degrees F, any RTV Silicone Sealant. For flue gas temperatures over 600 degrees F, Sauereisen #33 ceramic joint cement or its equivalent.

PART 3 - EXECUTION

3.1 TYPE B FLUE VENTS

A. Install gas vents in accordance with manufacturer's installation instructions. Maintain UL-Listed minimum clearances from combustibles. Assemble pipe and accessories as indicated for complete installation.

B. The gas vent system shall be so engineered and constructed as to develop a positive flow adequate to exhaust all flue gases to outside atmosphere, without condensation within the vent or spillage at any appliance draft hood.

C. All parts of vent system shall be of Underwriters' Laboratories, Inc. listed double wall gas vent piping, and such piping shall be continuous from the appliance outlets into vent top or housing.

D. The gas vent piping shall be installed in full compliance with the terms of its listing, with the Manufacturer's installation instructions, and with jurisdictional Building Code representing good practice for such installations.

E. It shall be the responsibility of the Contractor to provide adequate accessibility, head room, and chase dimensions so that all vent connectors and vertical vents can be correctly sized, spaced and supported.

3.2 POSITIVE PRESSURE CHIMNEY AND MANIFOLD SYSTEM

A. Install in accordance with Manufacturers installation instructions. Maintain UL-Listed minimum clearances from combustibles as described in NFPA 211, Section 2-3.1 and Appendix A. Assemble manifold, stack and accessories as indicated for complete installation.

B. Seal inner pipe joints during field assembly with <any RTV Silicone Sealant> <a paste of Sauereisen #33 ceramic joint cement or its equivalent> to assure positive internal pressure requirements.

C. Terminate chimney pipe extending above roof surfaces as required by local code and Appendix D of NFPA 211.

END OF SECTION 15575

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15620 - FUEL FIRED HEATERS

PART 1 - GENERAL

1.1 RELATED WORK

A. Requirements: Provide Gas Fired Equipment in accordance with the Contract Documents.

B. Related work specified in other Sections:

Section 15010 - Basic Mechanical Requirements
Section 15050 - Basic Mechanical Materials and Methods
Section 15240 - Mechanical Sound and Vibration Control
Section 15250 - Mechanical Insulation
Section 15485 - Natural Gas System
Section 15990 - Testing, Adjusting and Balancing

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to providing the following:

1. Gas Valves in accordance with Section 15050 - Basic Mechanical Materials and Methods.
2. Exterior Gas Distribution Pipe and Fittings in accordance with Section 15486 - Fuel Gas System.
3. Interior Gas Distribution, Pipe and Fittings in accordance with Section 15485 - Natural Gas System.
4. Gas Flue vents in accordance with Section 15555 – Boilers, Drawings, Section 15575 - Breechings, Chimneys and Stacks.
5. Gas Fired High Intensity Radiant Heaters

1.3 QUALITY ASSURANCE

A. Quality control shall be in accordance with Section 15010 - 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 B31.2) Code for Fuel Gas 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. Gas Fired High Intensity Radiant Heaters

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 15010.

1. Gas Fired High Intensity Radiant Heaters

PART 2 - PRODUCTS

2.1 GAS FIRED HIGH INTENSITY RADIANT HEATERS

A. Acceptable Manufacturers: Schwank, Re-Verber-Ray, Co-Ray-Vac, Reznor.

B. Materials of Construction: Stainless steel burner housing, venture and tile retainers. Aluminum or aluminized steel shade. Ceramic radiant matrix.

C. Burner: Fixed orifice suitable for use at site elevation, atmospheric fire, direct vent.

D. Controls: Intermittent solid state ignition with 120v signal. Automatic lock out if flame is not detected in a reasonable time. Orderly shutdown if power is interrupted, with starting cycle initiated when power is restored. All controls factory mounted for single point connection in field.

E. Performance: Infra-red output = 60% of input.

PART 3 - EXECUTION

3.1 GAS PIPING

A. Gas piping shall be in accordance with Section 15485 - Natural Gas System.

3.2 GAS FLUE VENTS

A. Provide gas flue vents in accordance with Section 15575 - Breechings, Chimneys, Stacks, and Flues.

3.3 GAS FIRED UNIT HEATERS

A. Install per manufacturer's installation instructions and in accordance with jurisdictional building code.

END OF SECTION 15620

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15750 - 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 15010 - Basic Mechanical Requirements
Section 15050 - Basic Mechanical Materials and Methods
Section 15240 - Mechanical Sound and Vibration Control
Section 15250 - Mechanical Insulation
Section 15511 - HVAC Piping and Specialties
Section 15540 - HVAC Pumps
Section 15555 – Boilers
Section 15620 - Fuel Fired Heaters
Section 15850 - Air Handling Fans
Section 15851 - Air Handling Systems on Roof
Section 15955 - Electronic DDC Controls
Section 15990 - Testing, Adjusting and Balancing

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to providing the following:

1. Fan Coil Units

1.3 QUALITY ASSURANCE

A. Quality control shall be in accordance with Section 15010 - 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. Fan Coil Units

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 15010:

1. Fan Coil Units

PART 2 - PRODUCTS

2.1 FAN COILS - CABINET TYPE

A. Acceptable Manufacturers: Dunham-Bush, Modine, Carrier, Trane, A.A.F., KHD Co., Airtherm, ITT-Nesbitt, York, McQuay, Sterling, Beacon Morris.

B. Type: Cabinet fan coils shall be of the blow-thru cabinet type with hot water heating coil, capacities and model number as shown on the drawings.

C. Arrangement: Arrangement and cabinet type shall be as shown on the drawings.

D. Cabinet: Shall be constructed of 16 - gauge furniture grade steel. Metal surfaces shall be cleaned, phosphatized, prime coated, and all exposed surfaces shall be finished in a baked enamel, color to be selected by Architect. Units on white ceilings shall be white, baked-enamel finish.

E. Fans: Shall be all steel, multi-blade, forward curved, centrifugal-type fan which has been statically and dynamically balanced to eliminate vibration. Fans shall be two-speed direct-drive or driven by V-belt and cast-iron sheaves capable of 25% speed variation. Belts shall be oil and heat resistant.

F. Motor: Shall be of the split-phase, open-type, two-speed, sleeve bearing with resilient mount in the unit. Motor shall be suitable for current characteristics as shown on the drawings, with built-in automatic reset, thermal overload protection. Include all contactors/starters required for automatic operation.

G. Hot Water Heating Coil: Shall be serpentine connected and shall be of the finned copper-tubing type, and shall be hydrostatically tested to twice the working pressure.

H. Filters: Provide 1" thick, permanent, cleanable-type filter located in a frame in the return air stream. Filters shall be easily removable by removing front access panel.

I. Control: Unit shall have automatic temperature controls as specified in Section 15955 - Electronic Controls, and shall in addition have internal unit mounted, pre-wired two-speed switch, and "off".

2.2 FAN COIL UNITS

A. Acceptable manufacturers: Carrier, Trane, McQuay, York, Lanco, First Co, Williams, Customair, ETI.

B. Units shall consist of coils, drain pan assembly, filter, and centrifugal fan with drive mounted in a common cabinet for independent air delivery from a single unit. Units shall be complete except for controls. All oiling connections shall be extended to exterior of casing to facilitate maintenance without removing soundproofing on exterior of unit.

C. Casings shall be constructed of 16-gauge steel, phosphatized to assure paint adherence and finished with baked enamel. Casings shall be provided with 3/4" glass fiber material meeting NFPA 90A to prevent condensation.

D. Coils shall be 2-row or 4-row design, or as specified on schedules. Aluminum fins shall be mechanically bonded to 1/2 inch O.D. seamless copper tubes. All coils shall be specifically designed and circuited for water use. All coils shall be tested at 300 PSI.

E. Fans shall be forward curved, centrifugal blower type fans equipped with heavy-duty adjustable V-belt drive. A permanently lubricated bearing shall support the fan shaft. All fans shall be dynamically balanced.

F. Drain pans shall be integrally attached to coil casings and are complete with threaded pipe drain connection. All pans shall be galvanized for corrosion resistance and cover the entire coil length. Drain pans shall be waterproofed to prevent leakage.

G. Filters shall be provided on all units. Filters shall be one inch high efficiency throw-away type. Filter access shall be from the side of the unit.

H. Motors shall be as scheduled on the plans. Reference specification Section 15050 for additional requirements.

PART 3 - EXECUTION

3.1 FAN COIL UNITS (ALL TYPES)

A. Install in accordance with manufacturers instructions.

B. Provide access to filters, controls, shut-off valves, etc.

C. Route condensate drain to approved receptor.

D. Provide auxiliary drain pan with separate drain line extended to a conspicuous point to serve as an indicator that the primary drain is restricted.

END OF SECTION 15750

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15850 - AIR HANDLING FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Plug Fans

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 15010 - Basic Mechanical Requirements.
2. Section 15050 - Basic Mechanical Materials and Methods.
3. Section 15240 - Mechanical Sound and Vibration Control.
4. Section 15241 - Mechanical Seismic Control.
5. Section 15990 - 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 15010:

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.

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 15050.

2.2 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.

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, and shall be directly coupled to the fan. The motor and fan shall be easily removable thru the intake grille for service.

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. Mounting: Mount fans on vibration isolators, in accordance with manufacturer's instructions and Section 15240.

F. Seismic Restraint: Provide seismic restraints in accordance with Section 15241.

G. 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 16 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.

H. Duct Connections: Refer to Division 15 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 15850

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15851 - 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 15010 - Basic Mechanical Requirements
Section 15050 - Basic Mechanical Materials and Methods
Section 15240 - Mechanical Sound and Vibration Control
Section 15241 – Mechanical Seismic Control
Section 15250 - Mechanical Insulation
Section 15620 - Fuel Fired Heaters
Section 15955 – Electronic Controls
Section 15990 - Testing, Adjusting and Balancing
Section 15995 - Commissioning of HVAC

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. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged air handling units with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards: Comply with the following:

2. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards 300 and 301 for sound ratings.
3. ARI Compliance: Test and rate air handling units in accordance with ARI 430 "Standard for Central-Station Air Handling Units", display certification symbol on units of certified models. Test and rate coils in accordance with ARI 410 – "Standards for Forced Circulation Air-Cooling and Air-Heating Coils".
4. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

5. UL and NEMA Compliance: Provide electrical components required as part of air handling units, which have been listed and labeled by UL and comply with NEMA Standards. Units with factory wiring shall be factory UL or ETL approved and labeled.
6. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.
7. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".

D. The following shall be used as selection criteria and shall be as specified: Airflow rates, external static pressures, water flow rates. The following are to be equaled or bettered: Coil face velocities, filter face velocities, water pressure drops.

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.
2. Product Data: Submit manufacturer's technical product data showing dimensions, weights, capacities, ratings, detailed fan performance curves with operating point clearly indicated, motor ratings and electrical characteristics, sound power levels (inlet, outlet, and radiated), coil ratings, filter data, wiring diagrams, gauges and finishes of materials.

B. Submit printed Operating Instructions and Maintenance Data under provisions of Operating and Maintenance Data paragraph in Section 15010:

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver air handling units with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers. Deliver air handling units with all openings covered with plywood and fiber-reinforced plastic sheeting to protect the units while in transit.

B. Handle air handling units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to air handling unit manufacturer.

C. Store air handling units in clean place and protect from weather and construction traffic.

D. Comply with Manufacturer's rigging and installation instructions for unloading air handling units, and moving them to final location.

1.6 EXTRA STOCK

A. Provide one complete extra set of filters for each air handling unit.
B. Provide one spare set of belts for each belt-driven air handling unit.

PART 2 - PRODUCTS

2.1 PACKAGED ROOFTOP AIR HANDLING UNIT (VAV, DX COOLING, HYDRONIC HEAT, DIGITAL SCROLL COMPRESSORS)

A. Approved manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AAON
2. Mammoth
3. Governair
4. Addison
5. Trane
6. Carrier
7. York
8. McQuay

B. General Description:

1. Factory assembled, consisting of fans, motor and drive assembly, compressors, coils, dampers, plenums, filters, drip pans, and mixing box. Provide factory-fabricated and factory-tested air-handling units as indicated, of sizes and capacities as scheduled, and as specified herein.

C. Cabinet, Casing and Frame:

1. The cabinet and exterior panels shall be formed and welded heavy gauge steel (18 ga. min.). All exterior panels shall be fabricated from galvanized steel finished with a one-mil coat of baked acrylic enamel over an epoxy primer. All frames shall be painted with one coat of paint for maximum protection against rust.
2. Hinged access doors shall have lever type compression latches to provide quick access and a positive air seal. Doors shall be complete with a locking type door restrainer to protect doors against wind damage when open. Access shall be provided to the following components: blowers, filters, main control panel (compressor vestibule), evaporator and condenser.
3. Provide vapor proof service lights wired to switches in each aforementioned Section. Power for these lights shall be supplied from a transformer furnished and installed by unit manufacturer. Power shall be connected to the transformer from the house side of unit disconnect so that lights and service outlets are available when unit disconnect is "off".
4. All sections exposed to return air, supply air, or mixed air shall be insulated with 2", 1-1/2 lb. density fiberglass having an R-value of 8.7. All doors shall be double wall construction.
5. Provide a 14" high metal roof curb with nailer under the entire unit.

D. Access Doors:

1. Access doors shall be manufactured from 18 gauge G90 galvanized steel. The doors shall be double wall construction with 22 gauge solid metal liner on the inside. Corners of the doors shall be continuously welded for rigidity. Two inch 1.5 lb/cu ft. density insulation shall be sandwiched between the outer layer and the inner layer.

2. Two metal latches operable from either side of door shall be provided. Door opening shall be fully gasketed with continuous neoprene/EDPM rubber bulb type gasket rated for a constant exposure temperature range of -20°F to 160°F. All doors shall swing open against the AHU component section pressure except on outdoor units. Doors shall have door tiebacks to secure an open position.
. Door frames shall be made from 16 gauge galvanized steel or extruded aluminum with the outside of the door flush with the unit. Minimum door opening size shall be 24 in. x 60 in. (where unit height permits).

E. Condenser/Compressor Section:

1. The compressors shall be of the scroll type, including an oil separating system, oil sump and oil filter integral to the compressors. The compressor(s) shall have internal 3-phase solid state thermal motor protection. Provide 4 year extended compressor warranty.
2. Compressors shall utilize R-410a refrigerant.
3. The oil temperature shall be controlled during operation to maintain proper oil temperatures throughout the lubrication system. The oil shall be cooled by liquid refrigerant injection. An electric oil heater shall be supplied to maintain oil temperature during shutdown periods.
4. The evaporative condenser coils shall have all prime surfaces staggered copper tubes, copper headers, and ABS tube sheets to allow for expansion and contraction while avoiding galvanic corrosion. A subcooler integral to the condenser coil shall provide a minimum of 10 Degrees F. liquid subcooling. The coils shall be factory leak tested at 400 PSIG nitrogen under water. The condenser fans shall be direct drive aluminum airfoil propeller fans or fully enclosed centrifugal type and shall be arranged and isolated to prevent fan noise from penetrating the roof structure. Max. NC=40 below unit. Head pressure shall be controlled by modulating dampers and fan cycling from the hottest liquid line temperature leaving the condenser with unnecessary fans being cycled off for minimum electrical usage.

F. Main Control Panel:

1. The main control panel shall have an access door for direct access to the controls. The panel shall be equivalent to NEMA type 3R (rainproof) and shall contain a single, externally operated, moulded case switch (non-automatic circuit breaker) suitable for copper wire up to and including 3" conduit. Wire and conduit entrance shall be inside of unit curbing. The main control panel shall include the following:

   a. A power terminal block.
   b. A power transformer with 115-volt secondary and 115-volt control fuse.

c. A 24-volt control transformer and fuse.
d. Necessary relays.
e. A 115-volt terminal strip.
f. A 24-volt control terminal strip which shall contain wired terminals for all controls, numbered in accordance with the wiring diagram.
g. An isolated 24-volt field wiring terminal strip.
h. A literature pocket that shall contain a pre-start-up form, a start-up form, maintenance instructions, and unit wiring diagram.
i. A 115-volt convenience outlet.
j. A phase-failure and brownout relay.

2. The above components shall be in addition to electrical components associated with other sections that shall be incorporated in the main control panel to facilitate maintenance and troubleshooting. All components shall be identified with nametags and wired in accordance with National Electric Code.

G. Temperature Control Panel:

1. The equipment supplier shall mount and wire the ATC Contractor furnished hardware and provide interlocks and stop/starts as shown on the attached control diagrams.
2. The wiring shall be run to a dedicated terminal strip within the starter control panel in the unit. All wiring shall be color coded and tagged with the respective terminal strip numbers at termination points and at splices. All interlocks between supply fan, compressors, and evaporative condensers shall be by the unit manufacturer. All thermal safeties, oil pressure, high pressure, low-pressure safeties, and phase failure...etc. shall be furnished and wired by the unit manufacturer.
3. The ATC Contractor shall furnish the following items to the unit manufacturer for factory mounting, wiring and piping:

a. Discharge air, mixed air, return air, outside air sensors and (two) well-mounted suction temperature sensors.
b. Manual supply air duct pressure reset switch.
c. Outside return air damper motors, quantity of 4.

4. The unit manufacturer shall furnish stop/start and status of the supply fan, compressor #1, compressor #2 and relief fan. The unit manufacturer shall also furnish wired to the terminal strip slide gate control consisting of a common, drive open and drive closed termination point for each compressor. A factory furnished and installed pressure switch within the refrigeration circuit shall override the external slide gate control to prevent low suction pressures.

H. Blower Section (Plug Fan):

1. Single Airfoil Blowers (SAS): The blower wheel shall be single airfoil plug fan, single width/single inlet-SAS type, secured to a machined, ground and polished solid steel shaft. The shaft shall be coated with a rust inhibitor and shall be supported by two outboard bearings. The blower assembly shall be dynamically balanced. Bearings shall be of the self-aligning ball bearing pillow block type

and shall be designed for at least 200,000 hours average life. Drive shall be designed for at least 200,000 hours average life. Drive shall be by means of multiple V belts with a minimum service factor of 150%. Motors shall be heavy duty open drip-proof, high efficiency, 3 phase, 1800 rpm, mounted on a heavy duty steel frame supported by seismically restrained springs designed for minimum 95% isolation efficiency.

I. Outside Air/Return Air (OA/RA) Dampers:

1. Outside and return air dampers shall be constructed of 16 gauge galvanized steel, and shall be permanently mounted to round damper shafts. Damper shafts shall be mounted in permanently lubricated nylon bearings to assure smooth operation. Damper blades shall operate without clatter or binding. Outside air dampers shall be capable of limiting air leakage to 10 CFM/Ft. Sq. at a static pressure of 4 inches. (Ruskin Model CD-50 or equal.)
2. Damper actuators and controls shall be factory installed and tested.

J. Variable Air Volume:

1. The unit shall be capable of delivering a variable air volume by means of pulse-width-modulated variable frequency drive. Refer to separate specification Section 15910 for VFD requirements.

K. Filters:

1. Provide filter sections as scheduled on drawings and in accordance with Section 15885.

L. Filter Gauges:

1. Provide Dwyer 2000 magnehelic gauges factory installed on casing of AHU. Magnehelic gauges shall be accurate to $\pm 2\%$ of full range. Sensing probes and shut-off valves shall be provided for each gauge.

M. Exhaust (Relief) Fan:

1. Relief fan shall be direct drive, propeller type designed for low noise. Motors shall be open drip-proof, permanent split capacitor, 277 V., single phase, 1-1/2 horsepower, 1200 RPM with internal motor protection and permanently lubricated ball bearings. Motors shall be open drip-proof, 1-phase, 3 horsepower, 1200 RPM with internal motor protection and permanently lubricated ball bearings.
2. Each fan shall have an extruded aluminum backdraft damper. Arrow Model 800 or equal.
3. Fans shall be isolated from unit casing by rubber or spring isolators capable of eliminating any objectionable vibration from being transmitted to the roof structure.
4. Propeller fans shall be provided to exhaust 85% of the total system supply air.

N. Coils:

1. Coils shall be fully enclosed within casing and mounted on angle iron racks. Cooling coil racks shall be primed with zinc rich chromate primer. Removable coil access panels shall be provided to remove coils through casing wall.
2. Drain pans shall be 18 gauge, 304 stainless steel. Intermediate drain pans shall be interconnected with 1-inch copper drain lines.
3. Hydronic coils shall be designed for hot water service with 5/8" diameter tubing of 0.020" wall thickness. Maximum fins per inch shall be 12. Coils shall be hydrostatically tested at 400 Psig, and shall be suitable for working pressures and temperatures up to 200 Psig and 220 degrees F. Fin thickness shall be 0.006 inch minimum. Coils must have brazed U-bend return bends. Hairpin construction type coils will not be accepted.
4. Coils shall be certified in accordance with ARI Standard 410.
5. Pipe connections shall be on the same end, and shall be threaded.
6. Water coils shall be fully drainable.
7. Coils indicated as being cleanable shall have either a cleanout plug for each tube or shall have a gasketed removable header cover.
8. Refrigerant coils shall conform to ANSI B9.1 Safety Code for Mechanical Refrigeration. Provide copper tubing headers with connections extended through unit casing. Leak test coils to 300 psig. Dehydrate entire assembly, charge with dry nitrogen, and seal for shipment.

O. Outside Air Louvers:

1. Outside air louvers shall be of a storm proof design and shall be provided with 1/2" x 1/2" galvanized bird screen. A fully insulated divider deck shall be provided to separate outside air from return air.

P. Discharge Air Temperature Control:

1. The discharge air temperature setpoint shall be capable of reset from a 0-10 Volt signal (to reset the suction pressure upward during periods of low load) via the Master Control sequencer that shall have the capability of controlling the suction pressure of the scroll compressor system. Compressor start/stop shall be from an ambient thermostat furnished with the unit, interlocked with the supply fan and other safeties and timers as may be required by the manufacturer to provide reliable unit operation.

2.2 PACKAGED UNIT TEMPERATURE CONTROL SYSTEM

A. General: Each packaged rooftop A/C unit shall be furnished complete with all operational controls. All controls shall be factory installed and wired, except for duct sensors, operations sub-base, and room panels which shall be field installed by the Contractor. The control system shall be a solid state integrated control system consisting of a discharge sensor. There shall be a solid state master control module with relays programmed to operate the cooling, and the outside air dampers.

B. Cooling Control: The plenum sensor shall control the evaporator coil discharge temperature through the master control module. The discharge sensor through the amplifier output signal to the master control module shall control in sequence the atmospheric cooling and/or the refrigeration.

C. Economizer Control: There shall be a modulating spring return mixed air damper motor with a unit mounted integral minimum position adjustment potentiometer to operate the outside and return air dampers. The damper motor shall open to the minimum open position whenever the supply fan is on and shall remain in the minimum open position until the plenum space requires atmospheric cooling, subject to the mixed air low limit or the outside total heat (enthalpy) high limit. There shall be a mixed air low limit control to limit the mixed air temperature to 55 deg.F minimum, and an adjustable outside air total heat (enthalpy) high limit to return the mixed air damper motor to the minimum open position if the outside air conditions are above setpoint (field adjustable). An adjustable ambient cutout shall prevent refrigeration from operating below 55 deg.F.

D. Room Control Panel: A remote readout room panel shall be supplied with each unit. The room panel shall be supplied complete with the following:

1. Auto/off system switch
2. Night setback switch (optional)
3. Dirty filter indicating light
4. Cooling reset light
5. Fan system light
6. High pressure cutout
7. Low pressure cutout
8. Crankcase heater failure
9. Heater high limit cutout
10. Air flow failure

E. Pneumatic Control Interface: Provide interface with pneumatic control specified in Section 15950 - Controls.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install air-handling units level and plumb, in accordance with manufacturer's written instructions and recognized industry practices. Maintain manufacturer's recommended clearances.

B. Unless otherwise noted on the drawings or in Part 2, support roof-mounted units on factory-fabricated insulated galvanized steel roof curbs nominal 12" high. Construct with integral slope for mounting on sloped roof. Secure units to roof curb. Provide seismic restraint in accordance with Section 15241.

C. Arrange installation of units to provide access space around air-handling units for service and maintenance. Coordinate installation with the work of other trades.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:

1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.
2. Connect piping to air-handling units with flexible connectors.
3. Connect condensate drain pans using 1-1/4-inch minimum, Type L copper tubing. Extend to the nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

B. Duct installations and connections are specified in other Division 15 sections. . Make final duct connections with flexible connections.

C. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in Division 16.
2. Temperature control wiring and interlock wiring is specified in Section 15955 and 15050.
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Inspection: Arrange and pay for a factory-authorized service representative to perform the following:

1. Inspect the field assembly of components and installation of air-handling units including piping, ductwork, and electrical connections.
2. Prepare a written report on findings and make recommended corrective actions.

3.4 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust water coil flow, with control valves to full coil flow, to indicated gpm.

B. Adjust damper linkages for proper damper operation.

C. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face.

D. Comb coil fins.

E. 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.

F. Deliver one spare set of belts for each belt-driven air handling unit, obtain receipt from Owner that belts have been received.

3.5 COMMISSIONING

A. Final Checks before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping blocking and bracing.
2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Set outside-air and return-air mixing dampers to minimum outside-air setting.
7. Comb coil fins for parallel orientation.
8. Install clean filters.
9. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
10. Disable automatic temperature control operators.

B. Starting procedures for air-handling units:

1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.

    a. Replace fan and motor pulleys as required to achieve design conditions.

2. Measure and record motor electrical values for voltage and amperage.

C. Shut unit down and reconnect automatic temperature control operators.

D. Refer to Section 15990 "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

3.6 DEMONSTRATION

A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals.

B. Schedule training with at least 7 days advance notice.

END OF SECTION 15851

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Camp Williams Medical Unit Readiness Center
Riverton, Utah
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SECTION 15852 – VEHICLE EXHAUST SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Vehicle Exhaust Systems

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 15010 - Basic Mechanical Requirements.
2. Section 15050 - Basic Mechanical Materials and Methods.
3. Section 15240 - Mechanical Sound and Vibration Control.
4. Section 15241 - Mechanical Seismic Control.
5. Section 15990 - Testing, Adjusting and Balancing.
6. Section 15995 - Commissioning of HVAC

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of specified systems 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 units 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 blowers 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 15010:

1. All systems.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver systems with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle systems carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to fan manufacturer.

C. Store systems in clean dry place and protect from weather and construction traffic.

D. Comply with Manufacturer's rigging and installation instructions for unloading systems 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 VEHICLE EXHAUST SYSTEM

A. Acceptable Manufacturers: Subject to compliance with requirements, provide one of the following: Nederman, Car-Mon, OsKar, VentAire

B. Furnish and install vehicle exhaust fan and hose reel system of size and capacity shown on drawings.

C. Frame shall be constructed of heavy steel with access to all internal parts for servicing. The frame shall be coated with aluminum zinc alloy for corrosion resistance.

D. Rewind system shall consist of removable spring with automatic latch and lock mechanism. Spring tension shall be externally adjustable. Hose guides shall be provided for even re-distribution across the drum. Drum shaft shall be supported with ball bearings. Hose stop shall be externally adjustable.

E. Blower shall be direct drive, radial centrifugal type, with minimum 14 SMG housing. Blower shall be non-sparking silicon aluminum statically and dynamically balanced and shall run on permanently lubricated bearings. Blower noise level shall not exceed 68 dB(A) per ISO 6081 test.

F. Hose shall be similar to Nederman Type NS, rated for 600 °F service.

G. Motor shall be TEFC, provided per requirements of "Motors" in Section 15050.

H. The entire system shall be UL listed for vehicle exhaust service.

PART 3 - EXECUTION

3.1 INSTALLATION OF SYSTEMS

A. Install systems 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 systems for service as indicated, but in no case less than that recommended by manufacturer.

D. Do not operate systems 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. Mounting: Mount systems on factory wall bracket, in accordance with manufacturer's instructions and Section 15240.

F. Seismic Restraint: Provide seismic restraints in accordance with Section 15241.

G. 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 16 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.

H. Duct Connections: Refer to Division 15 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 that cannot be satisfactorily corrected.

END OF SECTION 15852

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Project No. 04043480

SECTION 15880 - AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED WORK

A. Requirements: Provide Air Distribution in accordance with the Contract Documents.

B. Related work specified in other Sections:

Section 15010 - Basic Mechanical Requirements
Section 15050 - Basic Mechanical Material and Methods
Section 15240 - Mechanical Sound and Vibration Control
Section 15250 - Mechanical Insulation
Section 15850 - Air Handling Fans
Section 15955 - Electronic Controls
Section 15990 - Testing, Adjusting and Balancing

C. Work installed but furnished by others:

1. Motorized outside, return and exhaust air dampers for supply fan/return fan systems per Section 15955.
2. Motorized dampers on life safety stair pressurization fans per Section 15955.

1.2 SYSTEM DESCRIPTION

A. The work includes but is not limited to the following:

1. Sheet metal work.
2. Acoustical duct lining and sound attenuators in accordance with Section 15240 - Mechanical Sound and Vibration Control.
3. Variable air volume terminal units.
4. Grilles, registers and diffusers.
5. Motorized backdraft dampers.
6. Gravity backdraft dampers.
7. Installation of automatic control dampers.
8. Filter bank.
9. Mechanical sound and vibration control in accordance with Section 15240.
10. Painting of duct interiors visible through registers, grilles and diffusers to be painted flat black in accordance with Section 15050.

1.3 QUALITY ASSURANCE

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. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
2. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
3. National Fire Protection Association (NFPA).

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. Sound attenuators.
2. Acoustical duct lining.
3. Variable air volume terminal units.
4. Grilles, registers and diffusers.

PART 2 - PRODUCTS

2.1 SHEET METAL WORK

A. Metal and Gauge: Unless specified otherwise, galvanized iron to be used throughout, fabricated, and installed so that no vibration or noise results. Fabricate from the best grade of mild steel sheets of the U.S. Standard gauge joint and seal recommended in the latest edition of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) manual.

B. Flexible connections to be made from neoprene coated glass fabric (Ventglas).

C. Access Door Hardware: Ventlok Series 100 latches, hinges, and gasketing to be used on doors less than four square feet in area; Series 200 on doors from four to eight square feet; Series 300 for larger doors or doors in medium pressure systems.

D. Dampers: Opposed blade type volume dampers shall be installed where called for on Drawings or otherwise necessary for proper balancing. Dampers shall have operating shaft extending horizontally to accept surface mounted duct hardware.

E. Damper Operator Hardware: Dampers with a shaft length of 12 inch or less shall be equipped with Ventlok No. 620, 1/4 inch dial regulators, with shaft lengths of 12 inch to 20 inch with Ventlok No. 635, 3/8 inch dial regulators and No. 607 end bearings. Larger dampers shall be controlled with Ventlok self-locking regulators No. 640 or 641 in 3/8 inch or 1/2 inch size, and shall be installed with No. 607 end bearings.

F. Fire Dampers: Provide fire dampers with sleeves where shown on drawings in accordance with the jurisdictional Building Code. Standard gauges of sleeves are 14

and 16 gauge depending on size of duct and 10 gauge sleeves apply where the fire damper cannot be mounted in a fire rated cavity wall. Dampers to be complete with spring catches and constructed in accordance with NFPA Bulletin No. 90A. Dampers to be shutter type, mounted out of the air stream on all supply ductwork and, unless noted or shown otherwise on all other ductwork.

2.2 ROUND FLEXIBLE DUCTWORK (INSULATED)

A. Approved Manufacturers: Genflex, Thermaflex, Wiremold, Cleva-Flex, Porter Co., P.P.G. Co., Flexmaster.

B. Insulated low pressure flexible duct system shall be a factory fabricated assembly consisting of a zinc coated spring steel helix, wrapped with a nominal 1 inch thick by 1 lb. per cubic foot density fiberglass insulation. Assembly shall be sheathed in a vapor barrier jacket. Inner liner shall be of continuous non-perforated aluminum copolymer forming a positive inner air seal, such that if the outer vapor barrier is punctured, no air will be lost. The composite assembly, including insulation and vapor barrier, shall meet the Class I requirements of NFPA bulletin No. 90A, and be labeled by Underwriters' Laboratories, Inc. with a flame spread rating of 25 or less, and a smoke developed rating of 50 or under.

C. Duct system shall include a Model CB coupling as an integral part of one end, factory installed for quick connection to an air outlet device. Opposite end shall have a "spin in" fitting with damper where "lift-out" ceilings occur.

D. Flexible ducts shall be installed in a fully extended condition, free of sags and kinks, using only the minimum length required to make the connection.

E. Where horizontal supports are required, flexible duct shall be suspended on 35 inch centers with a minimum 3/4 inch wide flat bending material. All joints and connections shall be made with 1/2 inch wide positive locking steel straps.

F. Insulated low pressure flexible duct system shall be equal to Flexmaster Type 5 - insulated.

G. Where "lift-out" ceilings occur, flex ducts shall be installed with volume damper in flex duct at connection to main duct.

2.3 REGISTERS, GRILLES AND DIFFUSERS

A. Steel outlets to be supplied with prime coat finish, unless specified otherwise. Aluminum outlets to remain unpainted.

B. Steel grilles, registers, diffusers, to be installed on white ceilings to be furnished with white baked-enamel finish.

C. Registers, grilles, and diffusers to be of size, capacity and performance complete with accessories as noted on schedule on Drawings.

D. Manufacturers: Titus, Anemostat, Krueger, Carnes, Metal Aire, Tuttle and Bailey Co., Barber-Coleman, Price.

2.4 LINEAR SLOT DIFFUSERS

A. Provide linear slot diffusers as shown in schedule on Drawings for type of ceilings shown on Architectural Drawings.

B. Casing shall be constructed of galvanized steel with inlet collar.

C. Casing shall be insulated with 1/2 inch thick dual density thermal and acoustical fiberglass insulation meeting NFPA 90A requirements.

D. Diffuser to be extruded aluminum with steel deflector to provide horizontal air throw. Exposed surfaces of diffuser to be finished with white enamel.

E. Manufacturers: Tempo (No Substitutions Allowed).

2.5 VARIABLE VOLUME SINGLE DUCT TERMINAL UNITS

A. General:

Provide high velocity terminal units of the single duct, cooling type with variable volume control, performance and capacities as scheduled on the drawings.

B. Construction:

1. Units to consist of fully insulated welded 26 gauge galvanized steel casing, with round or oval inlet collars. Calibrated volume setting mechanism to permit accurate field adjustment of maximum and minimum air volume. Service panels to give access to the regulator. Leakage through casing not to exceed 2 percent at 0.5 inch wg.

C. Performance:

1. Volume regulators to be of the mechanical type with instantaneous compensation for system static pressure fluctuations, completely independent of the volume setting mechanism. The regulator to maintain plus or minus 5 percent of constant set-point volume. Volume dampers will not meet this performance criteria and are not acceptable.
2. The unit manufacturer to furnish, when requested, certified sound power levels for both discharge sound and casing radiated sound, tested in accordance with ASHRAE Standard 36-72. Sound data based on prior ASHRAE Standards will not be acceptable.
3. The tests to be conducted in an American Diffuser Council (ADC) approved sound facility. The data to include the second through sixth octave bands for unit sizes with inlet static pressures. Attenuation factors to be clearly defined.

D. Controls:

1. The units to be equipped for variable volume operation.

2. Variable volume reverse acting pneumatic, operators to be furnished and installed by the unit manufacturer. A calibrated minimum air volume adjustment mechanism to be provided, accessible through a quick-opening panel.
3. Control tubing and control enclosures to meet Jurisdictional Building Code for ceiling return air plenum installation.
4. Units shall be equipped to open 100% on morning warm-up cycle.

E. Manufacturers: Trane, Carrier, York, Tempmaster.

2.6 GRAVITY BACKDRAFT DAMPERS< 2.0" w.c.

A. Provide weighted gravity backdraft dampers where shown on Drawings.

B. Manufacturer: Arrow "Series 400".

PART 3 - EXECUTION

3.1 SHEET METAL WORK

A. 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. Provide access doors in ductwork wherever required for observation and maintenance of dampers.

B. Duct Workmanship: Ductwork to be constructed and erected in a workmanlike manner. Ducts to be straight and smooth on the inside with neatly finished joints, airtight, and free from vibration under every condition of operation. The internal ends of slip joints to be made in the direction of the airflow. The ducts to be securely attached to the building construction in an acceptable manner. Changes in dimensions and shape of the ducts to be gradual. Duct sizes fall within the limiting dimensions indicated on the Drawings unless otherwise approved.

C. Duct Turns: 90 degree elbows up to 18 inches wide and 45 degree elbows consist of an inside radius of not less than 1/2 width of the duct or be furnished with single blade duct vanes with 2-1/4 inch blade spacing. 90 degree elbows larger than 18 inches to be equipped with air foil type duct vanes. Shop fabricated duct vanes to conform to details of the Sheet Metal and Air Conditioning Contractors National Association manual. Do not use air turns on high velocity ductwork unless specifically called out on Drawings.

D. Flexible Connections: Provide sound isolating flexible connections on the inlet and outlet of each fan to which duct connectors are made. At least one inch slack to be allowed in fabric connections to insure that no vibration is transmitted from fan to ductwork. The fabric can either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage.

E. Dampers: Opposed blade type volume dampers to be installed where called for on the drawings or otherwise necessary for proper balancing.

F. Install automatic control dampers as required and specified under Controls and Instrument Section 15950.

G. Ducts to be sealed per SMACNA Standards: Seal Class A for over 2 inches static pressure and Seal Class B for less than 2 inches static pressure based on fan estimated static pressure shown on Drawings.

H. Conduct a complete duct leakage test as outlined in the SMACNA Leakage Test Manual.

I. Where joints are not accessible for proper sealing, hand holes should be cut in duct and the joints sealed from the inside. Take special care to seal duct corners.

J. 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. Wherever ducts penetrate floors or fire walls, install safing insulation to maintain fire wall integrity.

K. Access doors, 12" x 12" size, shall be installed at all automatic dampers, including fire and smoke dampers and upstream and downstream of all reheat coils. The doors shall have full sized plexiglass view panels.

3.2 FANS

A. Rotation Arrow: Rotation of the fan to be checked on start-up and if there is no rotation arrow supplied by the manufacturer, install a correct rotation arrow.

END OF SECTION 15880

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SECTION 15885 - AIR CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Disposable panel filters.

B. Filter frames.

C. 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 15010 - Basic Mechanical Requirements

1.3 RELATED SECTIONS

A. Section 15851 - Air Handling Systems on Roof.

1.4 REFERENCES

A. ANSI/UL 586 - Test Performance of High Efficiency Particulate, Air Filter Units.

B. ANSI/UL 900 - Test Performance of Air Filter Units.

C. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

D. 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 printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 15010:

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 01700.

PART 2 - PRODUCTS

2.1 DISPOSABLE PANEL FILTERS

A. Acceptable Manufacturers: Cambridge, Continental, Farr, American Air Filter, ULOK Fiberbond, Flanders.

B. Media: 4 inch thick fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive, nominal size per manufacturer, MERV 11.

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.

F. Model: RM-6211, Manufactured by: Flanders.

2.2 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 per unit manufacturer, filter media, minimum 4 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 filters with positive sealing gaskets.

2.3 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. 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 15885

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SECTION 15900 - DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Low pressure ductwork.

B. Medium and high pressure ductwork.

C. Manufactured duct joints.

D. Casings.

E. Damper operator hardware.

F. Volume control dampers.

G. Gravity backdraft dampers.

H. Motorized pressure dampers.

I. Motorized backdraft dampers.

J. Triple lock aluminum round ductwork (uninsulated).

K. Insulated triple lock aluminum round ductwork.

L. Insulated flexible round ductwork.

M. Flexible duct fan connections.

N. Access door hardware.

O. Duct access doors.

P. 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 15955.

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 15010 - Basic Mechanical Requirements.

1.4 RELATED SECTIONS

A. Section 15050 - Basic Mechanical Material and Methods.

B. Section 15240 - Mechanical, Sound and Vibration Control.

C. Section 15250 - Mechanical Insulation.

D. Section 15955 - Electronic Controls.

E. Section 15990 - 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.

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, outside 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 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 15900 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. Polyvinyl chloride (PVC) ducts: conform to SMACNA - Thermoplastic Duct (PVC) construction manual and NFPA 91.

1. Acceptable manufacturers: Plastinetics Inc., Elson Thermoplastics; Harvel Plastics Inc.

D. Fasteners: Rivets, bolts, or sheet metal screws.

E. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

F. 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 MEDIUM AND HIGH 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.

C. Provide conical fittings constructed to conform to details of the Sheet Metal and Air Conditioning Contractors National Association Manual (SMACNA) in branch ducts of medium pressure take-offs to VAV boxes.

D. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

2.4 MANUFACTURED DUCT JOINTS

A. Manufacturer: Ductmate Industries, Inc., TDF, MEZ Industries or approved equal.

B. Transverse duct joints of medium pressure ductwork shall be made with the Ductmate System components of standard catalog manufacture.

2.5 CASINGS

A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards for 6-inwg load 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. 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.

2.6 DAMPER OPERATOR HARDWARE

A. Manufacturer: Ventfabrics Ventlok Regulators

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.

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 GRAVITY BACKDRAFT DAMPERS (LOW VELOCITY COUNTERBALANCE TYPE) (< 2" 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.

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, 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.

2.9 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.

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.

2.10 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.

2.11 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.

2.12 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.

2.13 AIRFLOW MEASURING DEVICES

A. Manufacturers: Cambridge Air Sentinel, Air Monitor Corp.

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 pressure ductwork per SMACNA Standards for Seal Class A. This includes all longitudinal 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 2000 IBC, on smoke management system ducts to 1.5 times the design pressure. Total leakage shall not exceed 5% of design flow.

3.2 MEDIUM AND HIGH PRESSURE DUCTWORK (2" w.c. or greater)

A. Do not use air turns on medium or high velocity ductwork unless specifically called out on Drawings. Where acoustical lining is required, provide turning vanes of perforated metal with glass fiber insulation. Weld in place.

B. Seal ductwork per SMACNA Standards for Seal Class A. Where joints are not accessible for proper sealing, cut hand holes in duct and seal the joints from the inside.

C. Conduct a complete duct leakage test as outlined in the SMACNA Leakage Test Manual.

D. Total leakage of each medium and high pressure duct system not to exceed recommendations in SMACNA Leakage Test Manual.

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.

3.4 DUCTWORK APPLICATION SCHEDULE

A.

AIR SYSTEM	MATERIAL
Low Pressure Supply (Heating Systems)	Galv. Steel
Low Pressure Supply (System with cooling coils)	Galv. Steel
Medium and High Pressure Supply	Galv. Steel
Return and Relief	Galv. Steel
General Exhaust	Galv. Steel
Medium and High Pressure Flex Duct.	Insulated Triple Lock Aluminum
Low Pressure Flex Duct	Insulated Flexible Round Duct
Shower and Locker Room Exhaust	Galv. Steel, Aluminum
Outside Air Intake	Galv. Steel
Combustion Air	Category IV Alloy

3.5 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.

3.6 GRAVITY BACKDRAFT DAMPERS (LOW PRESSURE SYSTEMS)

A. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

3.7 MOTORIZED BACKDRAFT DAMPERS

A. Provide motorized backdraft dampers where shown on drawings.

3.8 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.

3.9 FLEXIBLE DUCT FAN CONNECTIONS

A. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

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.

3.10 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.

3.11 AIRFLOW MEASURING DEVICES

A. Provide airflow measuring devices where indicated in accordance with manufacturer's recommendations.

B. Coordinate control connections with Contractor for Section 15955 - Electronic Controls.

END OF SECTION 15900

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15910 -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. Air handler supply fans
2. Secondary heating water pumps

B. The Variable Frequency Drive shall convert 208 volt, 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. The VFD shall be interfaced to the building control system as specified in Section 15955.

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.

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 15 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.

1.3 SUBMITTALS

A. Shop Drawings: Submit shop drawings and product data in accordance with Section 15010 – 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.

B. Operating Instructions and Maintenance Data: Submit printed operating instructions and maintenance data in accordance with Section 15010 – 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 and harmonic 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

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 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, circuit breaker or motor circuit protector (MCP). VFD shall have a minimum short circuit rating of 65,000 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 15955 contractor.

U. VFD shall meet the requirements for Radio Frequency Interference as specified by FCC regulations, Part 14, 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:

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 PI controller capable of closed loop control of motor speed based on external analog speed reference signals or programmed digital input signals.

H. VFD shall include an integral bypass motor starter. Include motor thermal overload and circuit breaker protection for bypass operation, and door-mounted selector switch.

I. VFD shall include an integral locking disconnect.

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.

2.5 POWER QUALITY

A. Compliance with IEEE STD. 519-1992 (Recommended Practices for Harmonic Control in Electrical Power Systems) shall be a requirement of this project. Harmonic filters (passive or active), phase multiplication devices, or any other components required to mitigate harmonic voltage and current to IEEE std. 519-1992 published levels shall be an integral part of the VFD system. Designs which are not pre-integrated and factory wired as part of the UL (or equal) labeled VFD system shall not be acceptable under this specification.

1. Designs which employ shunt tuned filters must be designed to prevent the importation of outside harmonics which could cause system resonance or filter failure.
2. Designs which cause voltage rise at the VFD terminals must document coordination with the total system voltage variation to eliminate nuisance tripping.
3. Designs which do not provide both true and displacement power factor (measured at the VFD system input terminals) of at least 95% or better at full load are not acceptable. Designs that allow leading power factor at minimum loads which create voltage rise on the line side of the VFD system are not acceptable.

B. Relevant data for VFD system vendor calculations to meet IEEE Std. 519-1992 requirements are as follows:

1. For the purpose of this specification, the Point of Common Coupling (PCC) as identified in IEEE Std. 519-1992, shall be the connection at which each individual VFD system (the offending non-linear load) is connected to the electrical distribution system (linear loads). Required voltage and current harmonic distortion measurements shall be taken at each individual VFD system PCC.

2. The load current (I_L) is used to calculate the IEEE Std. 519-1992 I_{SC}/I_L ratio required for determining acceptable maximum harmonic current distortion table values as reproduced below. For the purposes of this specification, this calculated current (I_L) shall be the total combined full load current of each VFD system supplied as part of this project.
3. The VFD system vendor is responsible to determine the short circuit current (I_{SC}) available at the PCC through the drawings, through coordination with other equipment suppliers, from the electric utility, and/or from actual job site electrical equipment nameplate or measurement data.
4. As a convenience, the IEEE Std. 519-1992 table of current distortion limits for general distribution systems (120 V through 69,000 V) is given below:

Current Distortion Limits for General Distribution Systems
(120 V through 69,000 V)

Maximum Harmonic Current Distortion in percent of I_L

Individual Harmonic Order (Odd Harmonics)

I_{SC}/I_L	<11	11≤h<17	17≤h<23	23≤h<35	35≤h	TDD
<20	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Even harmonics are limited to 25% of the odd harmonic limits above.

C. Documentation of IEEE Std. 519-1992 compliance shall be part of the commissioning required by the VFD supplier. Actual job site measurement testing shall be conducted at one half and full load and documented in the operation and maintenance manuals. Reports shall include the following data:

1. Data (text and graphical) shall be supplied showing voltage and current waveforms, THD (or TDD) and individual harmonic spectrum analysis in compliance with the above standards.
2. Power quality reports including transformer derate analysis, telephone influence factor, true and displacement power factor, and voltage and current imbalance reports shall also be supplied.

D. The following companies have been pre-approved to meet the harmonic testing and documentation section of this specification.

1. Energy Management Corporation, 801-466-2262.
2. Applied Automation, 801-486-8792

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.
3. Verify operation of all field signal control connections.
4. 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.
5. Make all parameter adjustments to tune and optimize the VFD system to the application. Record all configuration values as part of this report.
6. 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.

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 15910

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Riverton, Utah
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SECTION 15930 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. VAV Single Duct Terminal Units.

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 15010 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 15050 - Basic Mechanical Materials and Methods.

B. Section 15955 - Electronic Controls.

1.4 SUBMITTALS

A. Submit Product Data for the following items under provision of The General Conditions of the Contract:

1. VAV boxes.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 15010.

1. VAV boxes.

PART 2 - PRODUCTS

2.1 VAV LOW PRESSURE ZONE TERMINAL UNITS

A. Manufacturer: Tempmaster Type S.

B. Other acceptable manufacturers: Titus, Carnes, Krueger, Price, Metal Air, Carrier.

C. Terminal units designated of sizes shown of Drawings or terminal unit schedule. Units shall have factory catalog performance ratings which conform to cfm, static pressure, discharge and radiated sound power and attenuation designated.

D. Construction:

1. Cabinets constructed of zinc-coated steel. Casing fabricated to prevent air leakage of no more than 2% of rated air quantity at 1/2" pressure. Internal surfaces acoustically and thermally insulated with 1" glass fiber material surface treated to prevent erosion and having UL approval meeting NBFU and NFPA-90.
2. Air volume damper assemblies made from exactly dimensioned extruded anodized aluminum components. Damper blades shall have extruded ribs which key into grooved shaft for permanent fix of damper. All internal damper pivot points nylon fitted for noiseless operation requiring no lubrication. Damper assemblies constructed to prevent air leakage at 1" inlet static pressure.

E. Performance Testing and Rating:

1. Performance of units shall be rated in accordance with Industry Standard 880-94.

F. Controls:

1. Controls shall be electronic type as specified in Section 15955. Electric and electronic control devices shall be contained in a NEMA-1 enclosure with access panel sealed from airflow and mounted on side of VAV box.

G. Hot Water Coils:

1. Provide, where indicated, terminal units with factory mounted one or two row coils as indicated on schedules. Coils to be aluminum finned hot water heating coils of sizes and capacities indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide ceiling access doors or locate above easily removable ceiling components.

C. Support units individually from structure. Do not support from adjacent ductwork.

D. Connect to ductwork in accordance with Section 15900. Allow minimum 2.5 times duct diameter of straight duct at terminal inlet.

3.2 VAV SYSTEM POWERED LINEAR DIFFUSER ROOM TERMINALS.

A. Install units in strict accordance with Manufacturer's instructions.

B. Install thermostats, control components and control tubing as required to provide room temperature and design volume control as indicated on Drawings.

C. Install control tubing and control mechanism enclosures in accordance with Jurisdictional Building Code requirements for return air ceiling plenum installation.

D. Install accessories as required for operable and finished installation indicated.

E. Provide volume regulator on each slave unit where Drawings indicate adjusted disproportionate air volume settings on same thermostatic control.

F. Coordinate installation of VAV units with Contractor for Section 15990 - Testing, Adjusting and Balancing who will set each volume controller to CFM setting shown on Drawings, confirm that each master and slave unit has all control air connections properly made and confirm proper operation for automatic variable air volume temperature control.

G. Where indicated, install units designed with control components and air damper available from the occupied space where ceiling access is precluded by architectural design limitations.

H. Protect installed diffusers from possible damage to controls and bellows if spray painting is contemplated on diffuser and adjacent ceiling areas.

I. Install system powered wall mounted thermostats with amplifying regulators where indicated.

J. Install warm-up switches on units where indicated.

K. Install differential pressure switch to the standard VAV controls where indicated to interface with electric perimeter heating control specified in Section 15950 - Controls.

3.3 ADJUSTING VAV TERMINAL UNITS

A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to 25 percent full flow. Set units with heating coils for minimum 50 percent full flow.

END OF SECTION 15930

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15936 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Registers.

C. Grilles.

D. Louvers.

E. Gravity roof vents.

F. Roof hoods.

G. 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 15010 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 15050 - Basic Mechanical Materials and Methods: Painting of ductwork visible behind outlets and inlets.

B. Section 15900 - Ductwork and Accessories.

C. Section 15930 - Air Terminal Units.

D. Section 15990 - 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. Louvered penthouses.
2. Shop fabricated roof hoods.

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.
6. Gravity roof vents.

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

A. Acceptable Manufacturers: Titus, Anemostat, Barber Colman, Krueger, Carnes, Metal-Aire, Nailor-Hart, Tempo, Air Diffusion Products.

B. Rectangular Louvered Ceiling Diffusers:

1. Rectangular, adjustable pattern, stamped, multicore type diffuser to discharge air in 360 degree pattern with sectorizing baffles where indicated; Model TMS, Manufactured by Titus.
2. Fabricate of steel with baked enamel white finish.

2.2 CEILING REGISTERS AND GRILLES

A. Acceptable Manufacturers: Titus, Anemostat, Barber Colman, Krueger, Carnes, Metal-Aire, Nailor-Hart.

B. Ceiling Exhaust and Return Registers and Grilles. (Perforated Face):

1. Perforated and removable face; Model PAR, Manufactured by Titus.
2. Fabricate of steel with steel or aluminum frame and baked white finish.
3. Provide integral, gang-operated opposed blade dampers, operable from face for exhaust grilles in gypboard ceilings.
4. Grilles are to be UL Listed and Labeled for use in fire resistive ceilings having a 3 hour or less rating.

2.3 DOOR GRILLES

A. Acceptable Manufacturers: Titus, Metal-Aire, Barber-Colman, Anemostat, Krueger.

B. V-shaped louvers of 20 gauge steel, one inch deep on 1/2 inch centers; Model ___T70, Manufactured by Titus.

C. Provide 20 gauge steel frame with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

2.4 LOUVERS

A. Acceptable Manufacturers: Dowco, Airstream, Louvers and Dampers, Inc., Ruskin, Krueger, Air Balance, American Warming and Ventilating, Arrow, C. E. Sparrow, Greenheck.

B. Louvers: Provide in exterior wall where shown, storm proof, steel louvers, 6" stationary drainable type, 50% minimum free area, with blades, bracing and 1/4" mesh aluminum bird screen on back of louver. Provide louvers with factory Kynar paint finish, color by Architect. Frame & blades to be 16 gauge. Ruskin Model L6375D or equal. Louvers must bear the AMCA seal.

C. Fabricate louvers of 16 gauge formed steel with welded assembly.

D. Furnish with interior masonry strap anchors for installation. Exterior fasteners will not be acceptable.

2.5 GRAVITY ROOF HOODS

A. Acceptable Manufacturers: Acme, Louvers and Dampers, Inc., Penn Ventilator, Greenheck.

B. Fabricate air inlet or exhaust hoods in accordance with SMACNA Low Pressure Duct Construction Standards; Modell Fabra-Hood, Manufactured by Greenheck.

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 white baked enamel finish.

D. Provide minimum 12 inch high insulated curb base.

E. Make hood outlet area minimum of twice throat area.

2.6 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.

2.7 SMOKE AND FIRE VENTS

A. Manufacturers: Bilco, Dur-red or accepted equivalent.

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 print 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° fusible link and shall be labeled as being FM Approved or UL Listed. Installation shall be in accordance with manufacturer's instructions. Manufacturer shall guarantee against defects in material or workmanship for a period of five years.

D. Vent shall be provided with electrically fusible link to melt upon 24V current from smoke detector. Contractor shall provide photoelectric smoke detector with auxiliary contacts, 24V transformer and 24V wiring. Mount detector on inside of vent curb.

E. Provide replacement fusible links for both fire and smoke testing.

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 matté 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.

3.2 MOTORIZED ROOF VENTS

A. Install vents where indicated per manufacturer's recommendations.

3.3 SMOKE AND FIRE VENTS

A. Install vents where indicated per manufacturer's recommendations.

B. Submit to Engineer letter confirming operation of vents by fusing link on both heat and smoke. Replace fusible links and indicate such in letter.

END OF SECTION 15936

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Riverton, Utah
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SECTION 15955 – ELECTRONIC CONTROLS

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 15010 - Basic Mechanical Requirements
Section 15050 - Basic Mechanical Materials and Methods
Section 15240 - Mechanical Sound and Vibration Control
Section 15250 - Mechanical Insulation
Section 15511 - HVAC Piping & Specialties
Section 15540 - HVAC Pumps
Section 15555 - Boilers
Section 15850 - Air Handling Fans
Section 15851 - Air Handling Systems on Roof
Section 15880 - Air Distribution
Section 15990 - Testing, Adjusting and Balancing
Section 15995 - Commissioning of HVAC

1.2 SYSTEM DESCRIPTION

A. The work includes but is not limited to the following:

1. The automatic control system shall be electronic analog, digital or a combination of both. PID (Proportional Integral, Derivative) control algorithms shall be applied on all temperature, indoor air quality, and pressure applications as called for hereinafter in the control sequences.
2. Central building automation system with web-based stand-alone master controller, unit controllers for all controlled devices to communicate with master controller. The master controller shall be capable of trend logging all indoor air quality sensors on an hourly basis for a period of one year, and any other measured variables for a period of at least 3 months.
3. All control devices, valves and automatic dampers, wire, conduit, etc., as specified and required and connected so as to perform all functions and operate according to the specified sequences.

1.3 QUALITY ASSURANCE

A. Manufacturing and Installation Qualifications:

1. The Controls Subcontractor firm executing the work of this section shall have 3 years experience in work of similar scope and nature to that specified.

B. This work includes all material, equipment and appurtenant accessories necessary for or incidental to the installation of a complete solid-state electromagnetic system of Automatic Temperature Controls.

1.4 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and manufacturer's data for the following items in accordance with the General Conditions of the Contract:

1. Sensors.
2. PI & PID Controllers
3. Automatic control valves, schedule and wiring.
4. Thermostats.
5. Thermometers.
6. Gauges.
7. Control diagrams
8. Wiring diagrams
9. Control panels.

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 15010.

1. Controls and instrumentation.

C. Certificate: ATC Contractor shall submit a letter certifying completion of the control system in accordance with the Contract Documents.

D. Commissioning: Submit completed Commissioning Checklist FC-7, Controls.

PART 2 - PRODUCTS

2.1 SENSORS

A. Temperature sensors shall be of the thermistor (NTC) type with a high resistance change versus temperature change to insure good resolution and accuracy. Sensors shall be available for room, duct or well mounting. Sensors shall connect to remote controller by means of a two-wire unshielded cable. Room type sensors shall be available with built-in setpoint potentiometer. Sensors shall be available in various ranges to properly suit the application.

B. Carbon Dioxide Sensor and Transmitter: Carbon Dioxide (CO_2) sensors shall be Vaisala Model GM, or approved equal. Wall-mounted sensors shall be Model GMW21. Duct-mounted sensors shall be Model GMD20. Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output, for wall mounting.

C. Zone dampening sensor element shall be suitable for duct mounting and capable of dampening an individual zone sensor by electronically paralleling the zone sensor's signal. Sensor shall connect to controller by means of a two-wire unshielded cable. Sensor shall be of the thermistor (NTC) type.

D. Strap-on type sensor shall vary its resistance over its entire range of sensed water temperature from 50°F to 230°F in a pipe 3/4" to 2-1/2" in diameter without requiring immersion or well mounting. Sensor shall connect to controller by means of a two-wire unshielded cable. Sensor shall be of the thermistor (NTC) type.

E. Duct-mounted averaging type temperature sensor shall utilize a nickel resistance sensing element incorporated in a copper capillary of 27 feet. The sensor shall vary the output voltage with a change in temperature. Sensor shall connect to the remote controller by means of a three-wire unshielded cable. Temperature sensors utilized for freezestat purposes shall be mounted within 6" of bottom of an air handler floor.

F. Differential pressure sensor shall vary the output voltage with a change in differential pressure. The sensor shall connect to the remote controller by means of a three-wire unshielded cable.

G. Air velocity sensor shall be capable of linear indication of the velocity of air in a duct from 0 to 3000 FPM, and shall vary its output voltage with a change in air velocity. The sensor shall connect to the controller by means of a four-wire unshielded cable.

H. Outdoor air sensor shall be of the thermistor (NTC) type with a high resistance change versus temperature change. Sensor shall be available for outdoor or duct mounting. Sensor shall connect to remote controller by means of a two-wire unshielded cable. Outdoor type sensor shall be available with integral wind sensor which changes its output voltage with a change in wind velocity. Combination sensor shall connect to controller by means of five-wire unshielded cable.

I. Duct sensor/adaptor shall be of the thermistor (NTC) type and suitable for mounting directly to the back of the integral sensor/controller making it capable of duct temperature sensing as a single unit.

2.2 PRIMARY HVAC CONTROLLERS

A. Temperature/humidity/pressure controllers shall be plug-in proportional type with integrated circuits. Controllers shall be capable of having up to three separate outputs. Each output shall have separate zero and proportional band adjustments such that a single controller may operate heating and cooling with an adjustable dead band to meet D.O.E. requirements. Indicating lamps shall be provided for each output which will vary in intensity to indicate amount of output. Controller shall be available with either 0 - 20 VDC proportional output, two position, or any combination. Controller shall have internal switches for each output to change the output signal to either direct or reverse. Controller shall be available with integral electronic circuit for absolute high or low limit control.

B. Three-in-one controllers shall be a single unit capable of producing a discreet 0-20 VDC proportional output, one for each of three separate sensors. The three outputs shall have individual setpoint, zero adjustment and proportional band. Each output shall be provided with output lamps that vary in intensity to indicate the amount of output.

C. Three mode rate reset controller shall be of the proportional/ on-off type with adjustable integral and derivative actions. The controller shall be available with one or two outputs. Each output shall have individual zero adjust and output lamps which varies in intensity as the output varies. Each output shall be field selectable for direct or reverse action, and 0-20 VDC proportional or 0/20 VDC binary output. The controller shall be supplied with a switch to eliminate the integral and derivative functions for calibration purposes.

D. The sequencing controller shall be capable of receiving a proportional signal from a controller and outputting two discreet sequenced signals with individual zero and steepness adjust for each. Controller shall be supplied with a switch to select a direct or reverse-acting output. Each output shall have individual indicating lamps which vary in intensity at output varies.

E. Averaging controller shall be capable of receiving up to ten (10) 0-20 VDC signals from controllers and outputting two separate control signals, one the average of the cooling demands and the other the average of the heating demands. Each shall have individual steepness adjust and individual indicating lamps which vary in intensity as output varies. Controller shall be supplied with switches to select direct or reverse-acting output signals.

2.3 TERMINAL UNIT CONTROLS (VAV)

A. Each smart variable air volume controller shall be based on a minimum 8 bit microprocessor with control algorithms and default set points embedded in non-volatile memory and shall regulate zone temperature by regulating the volume of air supplied to the zone. This is accomplished by controlling zone air velocity at an appropriate setpoint which is reset by the space temperature. A PID type control algorithm shall reduce offset and overshoot. Proportional control shall not be acceptable. Each controller shall be stand-alone and have the following independently adjustable setpoints:

1. Heating Temperature
2. Cooling Temperature
3. Maximum Cooling Velocity
4. Minimum Velocity
5. Maximum Heating Velocity
6. Space CO2 / Outside air differential

B. Each controller shall be remotely addressable over a twisted/shielded multidrop pair of wires by a higher level computing device. Remote communications shall enable the following capabilities:

1. Reset all Setpoints
2. Read all Setpoints
3. Read Zone Temperatures
4. Read Duct Velocity

5. Initiate Zone Morning Warmup Mode
6. Initiate Zone Night Setback

C. Control, communication, and power circuits for each controller shall be electrically isolated to protect against transients and steady state pick-up.

D. Controller setup shall be simplified by function switches on the controller which command damper open or closed, go to minimum or maximum velocity, and exercise heat assist outputs. Under normal operation, these function switches shall be used to create an address, unique to each individual controller. Any address between 01 and 31 shall be possible.

E. All controllers shall be suitable for indefinite operation with or without communication to a higher level computer system.

1.	Transmission rate:	300 baud
2.	Word Length:	8 bits
3.	Operation:	Asynchronous Half-Duplex Two Wire
4.	Format:	Binary

2.4 INTEGRAL SENSOR/CONTROLLER

A. Controllers shall be available with one or two outputs of either the two position or 0-20 VDC proportional type. Each output shall have individual dead band and proportional band adjustments. Time proportioned three point floating type output controller shall have single output with PID characteristics such that sustained system offset is eliminated, and shall have time adjustment to coordinate damper stroke time with controller output, controllers shall have lamps to appropriately indicate controller output. Outputs shall be individually field adjustable for direct or reverse action. Controller shall be supplied with equipment necessary to effect adjustable night setback from a contact closure or adjustable low limit control from a sensor signal. Control shall be available as integral duct sensor/controller, or shall be capable of remote sensor and/or setpoint mounting. Two output controllers shall have adjustable dead band capable of meeting D.O.E. requirements.

2.5 HOT WATER CONTROLLERS

A. Weather dependent changeover controller shall be capable of binary switching based on outdoor temperature, and shall be available with one or two independent switches with individual setpoint differential, and switch for reverse or direct action switching. Controller shall be capable of receiving a varying electronic signal from a solar sensor for automatic reset of control point due to solar load. Output lamps shall be provided to indicate individual contact status. Controller shall be capable of fully adjustable night set-back or setup.

B. Constant temperature controller shall be of the proportional type with integral reset action to eliminate sustained system offset. The controller shall have a switch for selecting long or short integral reset times. Controller shall have an indicating lamp that will vary in intensity with controller output.

C. Hot water reset temperature controller with limits shall be of the time proportioned 3 point floating type with PDPT characteristics, or the 0-20 VCD proportional type with PI characteristics, such that the reset function eliminates sustained system offset. Controller shall be capable of resetting its control point automatically due to outdoor air temperature, and wind and/or solar loss/gain information transmitted from appropriate sensors. Controller shall be capable of adjustable night setback from contact closure. Reset schedule shall be fully adjustable with regards to outdoor air temperature, and solar and/or wind loss/gain influence. Output lamps shall be provided to indicated controller output status, on-off or varying as appropriate. Switch shall be provided on proportional controller to eliminate reset functions for calibration purposes. Limit adjustments shall be provided for maximum and minimum allowable hot water temperatures.

D. Hot water reset temperature controller shall be of the time proportioned 3 point floating type with PDPI characteristics, or the 0-20 VDC proportional type with PI characteristics, such that the reset function eliminates sustained system offset. Controller shall be capable of resetting its control point automatically due to outdoor air temperature and wind and/or solar loss/gain information transmitted from appropriate sensors. Controller shall be capable of adjustable night setback from contact closure. Reset schedule shall be fully adjustable with regards to outdoor air temperature, and solar and/or wind loss/gain influence. Output lamps shall be provided to indicate controller output status, on-off or varying as appropriate. Switch shall be provided on proportional controller to eliminate reset functions for calibration purposes. Lamps shall be provided to indicate an adjustable below/above freezing change-over temperature. Controller shall be capable of receiving a signal from a room compensation sensor and adjusting its control point to coincide accordingly.

E. Return water boiler controller with low limit shall be available with on 0-20 VDC proportional output and either one or two on-off outputs. It shall be capable of controlling up to three boilers based on return water temperature. Each cut-in point shall be individually adjustable. The controller shall have a 200 second switch-on time delay and shall be compatible with a return water low limit sensor to close the mixing valve if the water temperature decreases to the extent that boiler shock would result. Output lamps shall indicate controller output status, on-off or modulating as appropriate.

F. Return water sensor/controller shall be compatible with the boiler controller to throttle closed the secondary system mixing valve should the primary return water temperature drop below its adjustable setpoint.

2.6 CONTROL VALVES

A. Drive and valve for low volume heating water shall be for the modulating magnetic type with two-way screwed fittings. Valve shall spring return to its normal position in the absence of control power. Valve body shall be nickel plated brass, seat shall be brass, and inner valve material shall be ethylenepropylene rubber.

B. Valves for control of refrigerants shall be of the two-way or three-way modulating magnetic type. Valve body shall be of high pressure brass with solder connections and have a seat and inner valve of chrome nickel steel. The valve shall spring return to its normal position in the absence of control power.

C. Valves used for control of hot water shall be of the modulating magnetic type with a rangeability of at least 500 to 1. Valve body shall be cast iron, seat and inner valve material shall be chrome nickel steel. Valve sizes 2" and smaller shall be screwed and supplied with union fittings. Valve 2-1/2" and larger shall be flanged. Valves shall be of the three-way or straight-thru type as required by the sequence or shown on the mechanical drawings. Valve shall be equipped with hand wheel to allow manual position of valve in the absence of control power. Valves shall be of the spring return type that will return to their normal position in the absence of control power.

D. Valves used for fan coil or terminal reheat shall be of the modulating magnetic type with a rangeability of at least 100 to 1. Valve body and seat material shall be bronze. The inner valve and stem material shall be stainless steel. The valve shall be of the three-way type with 4 connections and an integral bypass. Valves shall be of the spring return type that will return to their normal position in the absence of control power.

2.7 DAMPER ACTUATORS

A. Actuators shall be of the push-pull type for either modulating or two-positioning control. Actuators shall stroke by a rotating motion of an overload-proof synchronous motor. Control voltage shall be either 24 VAC or 0-20 VDC as required by the application. Actuators shall be available with spring return to the fully extended position upon power failure. Three (3) point floating actuator shall be available with adjustable end switches. Minimum/maximum manual positioners shall be available for proportional motors.

B. Mixing box actuators shall be of the rotary or linear drive type as required, capable of permanent stall operation without damage. Rotary drive actuators shall have adjustable stop pins for stroke limit and shall fit directly over the damper shaft. Gears shall be nickel steel. Gears and bearings shall be oil impregnated for lifetime lubrication.

2.8 RESET TRANSMITTERS

A. The reset transmitter shall be used for both summer and winter compensation in conjunction with controllers for the gradual increase in temperature as a function of outdoor air temperature. The transmitter shall be suitable for connection to up to 100 controllers while using only one outside air sensor. Transmitter shall have the capability to interface with a solar sensor for adjustable solar compensation.

B. The reset transmitter shall be used for both summer and winter compensation in conjunction with controllers for the gradual increase in temperature as a function of outdoor air temperature. The transmitter shall be suitable for connection to up to 100 controllers while using only one sensor. The transmitter shall have cut-in point and summer and winter reset slope adjustments.

C. The universal reset transmitter shall be capable of receiving a signal from any one of a number of different sensors (temperature, pressure, humidity, etc.) and resetting the setpoint of up to five controllers based on a field adjustable reset schedule. The reset schedule may be either direct or reverse with high and low reset limits.

2.9 STEP CONTROLLERS

A. Binary step controller shall be controlled by a 0-20 VDC signal from a controller. The step controller shall utilize binary logic so that when controlling six unequal switched stages of electric heat the step controller will achieve 32 effective stages. Lamps on the face of the controller shall indicate which stages have been activated.

B. Step controller shall be controlled by a 0-20 VDC signal from a controller and shall switch on the stages in sequence in accordance with the fixed cut-in and cut-out points. The controller shall be available with six steps. Lamps on the face of the controller shall indicate which stages have been have been activated.

C. Adjustable step controller shall be controlled by a 0-20 VDC signal from a controller and shall switch on the stages in sequence in accordance with the selected cut-in points, differentials and time delays. The controller shall be available in up to four steps. Should more than four steps be required the controllers shall be capable of cascading to obtain the required number of stages. Lamps on the face of the controller shall indicate which stages have been activated.

D. The electronic positioning relay shall receive a 0-20 VDC proportional output from a controller and convert it to a 3-point floating signal to control reversible drive motors on valves and damper actuators. The operation shall be characteristically PID in nature such that sustained system offset is eliminated. Lamps on the face of the controller shall indicate the direction of operation.

2.10 INDICATORS

A. Remote indicator shall interface with sensor/controller to indicate measured value at the sensors. Indicator shall be capable of indicating temperature, pressure or humidity.

B. Multiple indicator shall interface with up to six sensor/controllers to indicate measured value at the sensors. A selector switch on the face of the indicator shall determine which variable is being measured. Indicator shall be capable of indicating temperature and humidity.

C. Industrial digital indicator shall be of the precision electronics and component type accurate to $\pm$ .05% of measured variable indicator shall be adjustable for indicating various ranges of temperature, humidity and pressure from different voltage, current, or resistance inputs.

D. Industrial analog indicator shall be high precision electronics and component type accurate to $\pm$ 1% of scale range, indicator shall be suitable for indicating various ranges and shall be available as a one or two unit indicator.

2.11 ALARM UNITS

A. The alarm indicator shall be capable of indicating a minimum of six alarms per module. When an alarm condition exists the appropriate lamp shall flash. The lamp shall continue to flash until the alarm unit has been reset regardless of whether the alarm condition has returned to normal. When the reset button is pushed and the alarm

conditions still exist, the lamp shall go to a steady lit condition until the alarm has cleared. The unit shall be equipped with a lamp test button.

B. The status indicator shall be capable of indicating a minimum of six statuses per module. The unit shall be equipped with a lamp test button.

C. Floating alarm unit shall interface with a controller to sense setpoint and measured value. The upper and lower alarm limits shall be adjustable on the face of the alarm unit and defined as an offset from the controller setpoint. The unit shall have indicating lamps to indicate which limit has been exceeded and "dry" SPDT contracts for remote alarm. Unit shall be available as single or dual alarm unit.

D. Stand alone alarm unit shall connect to remote temperature and/or humidity sensor and alarm when the upper or lower limits set on the face of the unit are exceeded. The unit shall have indicating lamps to indicate which limit has been exceeded and "dry" SPDT contacts for remote alarm. Unit shall be available as single or dual alarm unit.

2.12 TRANSDUCER AND INTERFACES

A. The electronic transducer shall be of the one or two input/output type suitable for interfacing a sensor and a recorder. Start point and steepness shall be fully adjustable for various ranges. Accuracy shall be $\pm$ 1% of final value.

B. The electro/pneumatic transducer shall receive a 0-20 VDC signal from a controller and convert it to a proportional 3-15 PSI output. The movement shall be of the electromagnetic type.

2.13 TIME CLOCKS AND OPTIMIZER

A. Time clock shall have separate 7-day and 24-hour dials, skip-a-day feature, and 12-hour spring reserve. Clock shall have selection switch for manual day, manual night and automatic operation. Clock shall be available with adjustable morning boost and shall have manual time correction adjustment.

B. Time clock for optimizer shall have a separate 7-day and 24-hour dials, skip-a-day feature, quartz movement with interconnecting outputs, and 72-hour spring reserve. Clock shall have selection switch for manual day, manual night and automatic operation.

C. Start time optimizer shall initiate optimum start time computations 9 hours before programmed occupancy and determined latest possible start time to need desired system conditions based on indoor and outdoor air temperature. Clock shall have morning boost capability and be compatible with quartz movement optimizer time clock.

2.14 MISCELLANEOUS

A. High temperature cut-outs (HTCO) shall be designed to be mounted in the return air or exhaust duct system and wired to shutdown fans when air temperature rises above its setpoint. HTCO shall be of the manual reset type and supplied for all fans over 2000 CFM.

B. Smoke detector shall be of the dual chamber ionization type to sense the particles of combustion. Smoke detectors shall be provided for all heating and cooling fans over 200 CFM and wired to shut down the fan on an alarm condition.

C. Low limit thermostats shall be line voltage type and used to detect low temperature conditions in an air stream which could cause freeze-up conditions in water coils. Controller shall be of the liquid-filled type responsive only to the lowest temperature sensed along any one foot length of its 20 foot measuring element. Controller shall be adjustable and of the manual reset type.

D. Flow switches shall be of the paddle type equipped with SPDT contacts to establish proof of flow. Flow switches shall be of the vapor-proof type similar to McDonnell Miller FS8-V.

E. Line voltage to 24 VAC transformer shall be supplied as required to provide adequate control voltage to control system.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation of the automatic control system shall be made and supervised by mechanics who are full time employees of the Controls Subcontractor.

F. All installation work shall be scheduled and coordinated with other trades to expedite job progress.

G. The installation shall match erection of slabs and walls such that no damage, cutting or patching will be required.

H. All work shall be installed in accordance with current control industry practices.

I. Only top quality workmanship will be permitted.

J. Any work not properly executed shall be removed and replaced without extra expense to the Owner.

3.2 SENSORS AND GUARDS

A. Temperature controls trades shall verify all wall mounted sensor locations with the General Contractor in order to avoid interference with wall mounted furnishings.
1. Where interferences require moving the sensor more than two feet, consult with the Engineer for new location.

B. Calibrate each carbon dioxide sensor for site elevation (4500 ft) prior to placing into service.

3.3 FREEZE PROTECTION THERMOSTATS

A. Provide freeze stat on the discharge of each unit to stop the fan and close the outside damper upon sensing any one foot section below 40°F.

3.4 ELECTRIC WIRING

A. All control and interlock wiring shall be as specified in "Electric Wiring" paragraph in Section 15050 - Basic Mechanical Materials and Methods. Provide diagrams and coordinate all work with the Division 16 contractor as required.

B. The ATC Contractor shall furnish and install all required wiring for the following subsystems:

1. Water Treatment System

C. The ATC Contractor shall furnish all necessary equipment and wiring to integrate the following:

1. Boiler
2. Generator
3. Lighting

3.5 SERVICE AND WARRANTY

A. The control system herein specified shall be free from defects and workmanship and material under normal use and service. After completion of the installation the controls contractor shall regulate and adjust all thermostats, control valves, damper motors and other equipment provided under this contract. If within twelve (12) months from the date of completion any of the equipment herein described is proved to be defective in workmanship or materials, it will be replaced or repaired free of charge in accordance with "Warranties" paragraph in Section 15010.

B. The controls contractor shall after completion, provide any service incidental to the proper performance of the control system under guarantees outlined in Division 1 for the period of one year.

C. When all devices are installed, a fully qualified technician shall set, adjust and calibrate all components.

1. A letter certifying completion of the system shall be forwarded to the Engineer's office, prior to acceptance of project by Owner.

3.6 INSTRUCTION AND ADJUSTMENT

A. On completion of the job the controls contractor shall have completely adjusted the entire control system. He shall arrange to instruct the Owner's representative on operation of the control system and supply him with three (3) copies of the control operating and instruction manuals. He shall obtain from the owner's representative a signed receipt that he has received the instruction manuals and complete instructions on the operation of the system.

B. Record Drawing: At completion of the job the controls contractor shall furnish two (2) copies of corrected wiring diagrams, one enclosed in laminated plastic and mounted on wall of the main mechanical room or as directed.

C. Contractor Adjustments: At the completion of the job the controls contractor must submit to the Architect a letter stating that he has made final calibrations and adjustments to the system and that the owner's operating personnel have been instructed in its use.

3.7 SEQUENCE OF OPERATION

A. Rooftop Air Handling Unit RTU-1:

1. Occupied/unoccupied modes of this air handler shall be determined by a four-channel load programmer and override timer located on the Automatic Temperature Control (ATC) panel.

2. Occupied Mode:

a. When the air handler is indexed to the occupied mode, the outside and exhaust dampers shall remain closed until the return air temperature comes up to 68 degrees (adjustable). When the return air rises above 68 degrees, the outside air dampers shall open to a minimum position adjustable at the ATC panel.

b. A discharge three-mode controller with proportional, integral and derivative action shall select the zone calling for thermostat cooling and reset the discharge air temperature from 65 to 53 degrees with adjustable limits. This controller shall sequence the return plenum unit heater, outside air dampers, 2 stages of compressor operation, and modulate the hermetic hot gas valve provided by this contractor to satisfy the reset schedule.

c. A differential controller sensing the outside and the return air temperatures, shall return the outside air dampers to minimum position when the outside air temperature is within 2 degrees of the return temperature. The mechanical cooling shall be locked out below 55 degrees OSA (adjustable).

d. Minimum outside air shall be set at 2700 CFM minimum (adjustable).

2. Unoccupied Mode:

a. The air handler shall be off, the outside air dampers shall be closed, and the cooling locked out. On a fall in space temperature below 60 degrees as sensed by zone temperature controllers, the air handler shall start to satisfy the space heating demand.

3. Zone Control:

a. All zones. A panel-mounted master/submaster controller with separate heating/cooling setpoints sensing the space temperature and zone discharge temperature with remote transmitters shall modulate hot water valve to satisfy the space heating setpoint. The cooling output of the controllers shall reset the main supply fan discharge air temperature.

4. Supply Fan Speed Control:

   a. Supply fan VFD shall modulate to maintain a pressure differential between the space and discharge ductwork sufficient to operate all VAV boxes with at least one box in the full open position at any time.

5. Power Exhaust Fan Speed Control:

   a. Power exhaust fan VFD shall modulate to maintain a pressure differential between the lobby and outside air.

6. Safeties:

   a. Shut down all fans under smoke detector or freezestat alarm.

7. Interlocks:

   a. All exhaust fans shall be interlocked to run when the supply fan AHU-1 unit is in operating, economizer mode, and to de-energize with AHU-1.

K. Heating Water System:

1. Upon a call for zone heating or air handler preheat, the lead boiler shall be enabled and the boiler primary pump shall be enabled. The burner controls shall be monitored by the central control system. The lead position shall alternate between each primary pump and boiler to periodically exercise each piece of equipment. Operating status of each pump shall be monitored by adjustable setpoint motor current sensors. Upon pump or motor failure, a failure alarm shall be indicated and the lag or backup pump shall automatically start. Pump failure alarm shall generate an automatic pager or e-mail notification as directed by Owner. Lag boiler shall be enabled as needed to maintain the primary heating water temperature setpoint (160°F). The primary loop 3-way valve shall modulate to maintain the secondary heating water temperature setpoint. The secondary heating water temperature shall be reset from 150°F to 100°F over the range of outdoor temperature from 10°F to 60°F.
2. Upon a call for heating water from within the secondary zone, the lead secondary heating water pump speed shall modulate to maintain the differential pressure sensor setpoint. Secondary pump speed shall be controlled directly through the VFD integral PID controller. Status of all pumps shall be monitored by adjustable setpoint motor current sensors, upon loss of flow an alarm shall be indicated and the lag or backup pump shall be enabled automatically. Pump failure alarm shall generate an automatic pager or e-mail notification as directed by Owner.

L. VAV Boxes:

1. Occupied Mode:

   a. When the space temperature is equal to or greater than the cooling temperature set point the VAV box processor shall enter the cooling mode. The controller shall reset the box CFM set point from the

minimum ventilation set point to the cooling maximum set point. A velocity sensor shall measure airflow through the terminal unit and compare this to setpoint. The controller shall modulate the damper through PID control action to maintain volume setpoint. The space temperature sensor resets the volume setpoint to maintain the room temperature at the desired setpoint of 75°F (adjustable). Provide adjustable minimum and maximum volume limits.

b. On a fall in space temperature equal to the heating temperature set point, the controller shall than modulate the reheat coil as well as reset the supply air volume between the ventilation minimum and the heating maximum set point. The heating volume shall be a function of the heating calculation percentage to minimize the amount of reheat. On a 100% call for heat, the VAV box shall control to the maximum heating velocity set point and the control valve shall be wide open. (Reference Paragraph I)

c. Minimum airflow shall modulate from the scheduled control minimum to the scheduled heating maximum to maintain space CO_2 level less than 400 PPM (adjustable) above outside air CO_2 level as measured at the outside air intake of RTU-1. CO_2 differential shall be determined at intervals of not more than 2 minutes using the average readings of the previous period.

2. Unoccupied Mode:

a. No cooling shall be permitted.
b. Heating shall occur in a similar action to the occupied mode except room temperature shall be 60°F (adjustable).

M. Fan Coil Unit FC-1:

1. When space temperature falls below setpoint (adjustable), energize fan and modulate heating water control valve to maintain setpoint.

N. Fan Coil Unit FC-2:

1. Occupied Mode:

a. The fan shall run continuously in the occupied mode, which shall be determined by a wall mounted occupancy sensor with 3-hour occupied override.
b. The fan coil controller shall regulate zone temperature by modulating the heating valve via PID control action to maintain setpoint.
c. Cooling is not provided for this unit.
d. Outside air and return air dampers shall modulate between 0 and 1400 CFM to maintain space CO_2 level less than 400 PPM above outside air CO_2 level as measured at the outside air intake of RTU-1.

2. Unoccupied Mode:

a. No cooling shall be permitted.
b. Outside air shall be closed.

c. Heating shall occur in a similar action to the occupied mode except room temperature shall be 55°F (adjustable).

O. Split System FC-3 matched with CU-1:

1. When space humidity rises above 60% (adjustable), energize dehumidification mode – condensing unit on, fan coil on, modulate hydronic heating control valve to maintain discharge air temperature equal to space temperature. De-energize the system and close the hydronic heating control valve after space humidity falls below 50% (adjustable).

P. Central Control Panels:

1. Provide two steel panels to house the controllers, relays, and similar instruments for each system as described below. Locate one panel in mechanical penthouse and one panel basement vestibule.

a. Central Air Handler Controllers with their setpoints.
b. Space temperature setpoints for each zone of AHU-1 system.
c. Humidity setpoint for each operating room and recovery room.
d. Space temperature readout, setpoint, and velocity operating points for each VAV or fan powered box.
e. Digital outside air, return air, mixed air, and discharge air indication for each handler.
f. Duct and space static pressure indication for 2 VAV systems.
g. Hand-off auto switches for all pumps boilers and air handlers.

END OF SECTION 15955

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15990 - 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. Related work specified in other Sections:

Section 15010 - Basic Mechanical Requirements
Section 15995 - Commissioning of HVAC

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

1. Upon completion of the installation of all the air and 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 15010, paragraph 1.16.
4. Provide assistance, in cooperation with the various trades, in the final adjustments and test of the Life Safety Systems.
5. Completion of Functional Checklists FC-1 through FC-6, Section 15995, paragraph 3.5.
6. Provide Owner training as described in Specification Section 15010.

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 Testing, Adjusting and Balancing subcontractor meeting the above Quality Assurance requirements. Acceptable separate professional subcontractors meeting the above requirements are as follows:

1. BTC Services, Inc.
2. Certified Testing & Balancing, Inc.
3. Payson Sheet Metal
4. RS Analysis, Inc.
5. Intermountain Test & Balance
6. Diamond Test & Balance

G. Subcontractors not listed above must submit for acceptance.

H. Within 30 days after execution of the Owner-Contractor Agreement, transmit to Architect/Engineer the name and qualifications 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. 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.
10. 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.

11. Sound pressure levels showing readings in all 8 octave bands and plotted on NC charts shall be submitted for the following:

    a. All sides of Mechanical Rooms.
    b. All spaces exhibiting abnormally high or annoying noise levels.

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 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 handled by each pump and supplied to each 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, bands 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 16 Contractor of any thermal overloads that need to be changed/replaced.
3. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 0.25 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. Dust collection system shall be adjusted for air quantities shown on the Drawings with all blast gates open and all floor sweeps closed.
11. Set all VAV boxes at minimum air flow shown on drawings.
12. Adjust air flow switches for proper operation on all fan powered VAV boxes.
13. Test Run: In order to determine that the system installation is complete and will operate satisfactorily, make a test run with equipment operating per normal temperature control schedule and sequence for a period of seven days for each heating and cooling season. Contractor shall notify Architect in writing when he is ready to begin test. Provide personnel to run test and operate and adjust equipment as may be required during test run. Keep a log for each day indicating all malfunctions that occurred and corrections and adjustments made. Be responsible for operation of equipment during this test.
14. 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.

END OF SECTION 15990

Utah National Guard
Camp Williams Medical Unit Readiness Center
Riverton, Utah
Project No. 04043480

SECTION 15995 - COMMISSIONING OF HVAC

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 commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.
2. Section 15511 - HVAC Piping & Specialties
3. Section 15540 - HVAC Pumps
4. Section 15555 - Boilers
5. Section 15851 - Air Handling Systems on Roof
6. Section 15852 - Vehicle Exhaust System
7. Section 15955 - Electronic Controls
8. Section 15990 - Testing, Adjusting, and Balancing

1.3 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.4 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.5 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning report:

1. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
2. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
3. Test and inspection reports and certificates.
4. Completed functional checklists.
5. Corrective action documents.
6. Verification of testing, adjusting, and balancing reports.

1.6 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Tests will be performed using design conditions whenever possible.

E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

F. The CxA may direct that set points be altered when simulating conditions is not practical.

G. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

H. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 15 boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 15 Sections 15955 - Electronic Controls. Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 15 piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section.• Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of gas, hot-water systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

3.5 FUNCTIONAL ATTACHMENTS

A. FC-1 Packaged DX Air Conditioning

B. FC-2 Boilers

C. FC-3 Pumps

D. FC-4 Vehicle Exhaust Fan

E. FC-5 Hot Water Piping

F. FC-6 VFD

G. FC-7 Controls (By Division 15995)

H. Mechanical Basis of Design

END OF SECTION 15995

Camp Williams Readiness Center
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Camp Williams Readiness Center
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SECTION 16001 - ELECTRICAL GENERAL PROVISIONS

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.

B. Architectural, Structural, Mechanical and other applicable documents also apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. The contract documents indicate the extent of electrical work. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system as described in div 16000.

1.3 RELATED SECTIONS:

A. Other Divisions relating to electrical work, apply to the work of this section. See other applicable Divisions including, but not necessarily limited to:

1. General and Supplementary Conditions
2. Division 2 - Site Work
3. Division 3 - Concrete
4. Division 5 - Metals
5. Division 6 - Wood and Plastics
6. Division 7 - Thermal and Moisture Protection
7. Division 8 - Doors
8. Division 9 - Finishes
9. Division 15 - Mechanical Systems

1.4 INTERPRETATIONS OF DRAWINGS AND SPECIFICATIONS:

A. Prior to bidding the job, submit requests for clarification in writing to the Architect/Engineer prior to issuance of the final addendum.

B. After signing the contract, provide all materials, labor, and equipment to meet the intent, purpose, and function of the contract documents.

C. The following terms used in Division 16 documents are defined as follows:

1. "Provide" - Means furnish, install, and connect, unless otherwise indicated.
2. "Furnish" - Means purchase new and deliver in operating order to project site.
3. "Install" - Means to physically install the items in-place.
4. "Connect" - Means make final electrical connections for a complete operating piece of equipment. This includes providing conduit, wire, terminations, etc. as applicable.
5. "Or Equivalent" - Means to provide equivalent equipment. Such equipment must be approved by the Engineer prior to bidding.

1.5 EXAMINATION OF SITE:

A. Visit the site and verify existing field conditions prior to submitting bid.

B. All costs arising from site conditions and/or preparation shall be included in the base bid. No additional charges will be allowed due to inadequate site inspection.

1.6 QUALITY ASSURANCE:

A. Perform work in accordance with all governing codes, rules, and regulations including the following minimum codes (latest editions or as otherwise accepted by the Authorities Having Jurisdiction):

1. National Electric Code (NEC)
2. International Building Code (IBC)
3. International Fire Code (IFC)
4. International Mechanical Code (IMC)
5. International Plumbing Code (IPC)
6. American Disability Act (ADA)
7. National Electrical Safety Code (NESC)
8. Local Codes and Ordinances

B. Comply with all standards where applicable for equipment and materials including the following minimum standards:

1. Underwriter's Laboratories (UL)
2. American Society for testing Materials (ASTM)
3. Certified Ballast Manufacturers (CBM)
4. Insulated Cable Engineers Association (ICEA)
5. National Electrical Manufacturer's Institute (NEMA)
6. American National Standards Institute (ANSI)
7. Electrical Testing Laboratories (ETL)
8. National Fire Protection Association (NFPA)
9. Institute of Electrical and Electronics Engineers (IEEE)
10. American Institute of Electrical Engineer's Electrical Power
11. Systems and Grounding in Commercial Construction
12. Illuminating Engineers Society (IES)

C. Provide new electrical equipment conforming to all requirements as set forth in the above standards. Provide UL labeled equipment where such label is applicable.

D. Comply with all state and local codes and ordinances. When conflicts occur among codes, standards, drawings, and/or specifications, the most stringent requirements shall govern.

E. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Provide a certificate of approval to the owner's representative from the inspection authority at completion of the work.

F. Provide only quality workmanship conforming to the best electrical construction practices.

G. The contractor shall have a current state contracting license applicable to type of work to be performed under this contract.

1.7 SUBMITTALS:

A. Shop Drawings: After the contract is awarded, but prior to manufacture or installation of any equipment, submit eight (8) complete sets of shop drawings. Partially complete sets of shop drawings are not acceptable. Submit all shop drawings in one complete submittal package. Prior to submitting shop drawings, review and certify that they are in compliance with the contract documents; Sign all approved shop drawings. Allow a minimum of two weeks for architect/engineer to review shop drawings. Refer to architectural general provision section for additional requirements.

B. Provide equipment catalog "cut sheets", brochures and/or drawings which clearly describe the proposed equipment. Include plans, elevations, sections, isometrics, and detailed engineering and dimensional information as applicable including equipment room layouts. Electrical room layouts are required to show all electrical equipment locations for all projects that include electrical rooms. Do not submit catalog sheets which describe several different items in addition to those items to be used, unless all relevant information is clearly identified. Bind each information set in three ring binder or binders of sufficient size or sizes to enclose all information. Organize all information by section. Provide separate tabbed covers for each section of Division 16 indicating section number for each section requiring submittals.

C. Include on front cover of binder or binders the name and location of the project, architect, electrical engineer, general contractor, electrical contractor, subcontractors, supplier/vendor, order number, volume, date, and any other applicable information. Certify that shop drawings are submitted in accordance with the contract documents with a written statement indicating compliance. Submittals will be reviewed and comments produced two times maximum. Additional reviews will be billed at current rates.

1.8 OPERATION AND MAINTENANCE MANUALS:

A. Submit four (4) complete sets of operating instruction and maintenance manuals for all equipment and materials provided under Division 16.

B. Provide manufacturer's recommended operating and maintenance instructions, cleaning and servicing requirements, serial and model number of each piece of equipment, complete list of replacement parts, performance curves and data, wiring diagrams, warranties, and vendor's name, address, and phone numbers. Do not submit information which describe several different items in addition to those items to be used, unless all relevant information is clearly identified. Assemble all data in completely indexed volume or volumes. Engrave the job title, and name, address, and phone numbers of the contractor on the front cover and on the spine. Incomplete O&M manuals will be returned to the contractor for corrections / additions.

1.9 RECORD DRAWINGS:

A. Maintain on a daily basis a complete set of "Red Lined Drawings", reflecting an accurate record of all work including addendums, revisions, and changes. Indicate precise dimensioned locations of all concealed work and equipment, including concealed or embedded conduit, junction boxes, etc. Record all "Red Lined Drawing" information on a set of full sized prints of the contract drawings.

B. Certify the "Red Lined Drawings" for correctness. Indicate on each drawing the name of the general and electrical contractors with signatures of each representative responsible for the work.

C. The electrical engineering design firm will create record (as-built) drawings from the certified red lined drawings, however, the general and electrical contractors retain the responsibility for the accuracy of the record drawings.

1.10 WARRANTY:

A. Ensure that the electrical system installed under this contract is in proper working order and in compliance with drawings, specifications, and/or authorized changes and is free from electrical defects. Without additional charge, replace or repair, to satisfaction of the owner's representative, except from ordinary wear and tear, any part of the installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance or as otherwise indicated in individual sections, but in no case less than one year. Warranty incandescent and fluorescent lamps only for a period of two months from the date of substantial completion.

B. Provide complete warranty information for each item including beginning of warranty period, duration of warranty, names, addresses, and telephone numbers and procedures for filling a claim and obtaining warranty services. Include this information in the operation and maintenance manuals.

PART 2 – PRODUCTS

2.1 GENERAL:

A. All materials shall be new and shall bear the manufacturer's name, trade name, and the approved testing laboratory such as the UL label in every case where a standard has been established for that particular material. Used materials are acceptable only if specifically indicated on drawings.

2.2 SUBSTITUTION OF MATERIALS:

A. Provide only specified products or products approved by addendum. Substitutions will be considered if two copies of the proposal is received at the architect's/engineer's office eight (8) working days prior to the bid day. Include in the proposal the specified and proposed catalog numbers of the equipment under consideration and a catalog cut sheet(s) with pictorial and descriptive information. Certify that the equipment proposed is equal to that specified, that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents.

B. It is the responsibility of the contractor to make all substituted equipment comply with the intent of the contract documents and bear all cost associated with conflicts arising form the use of substituted equipment.

C. Provide samples if so required by the architect or engineer before or after bid day.

2.3 SPARE PARTS:

A. Provide spare parts as specified in Division 16 sections. Deliver all spare parts to owner's representative prior to substantial completion.

PART 3 – EXECUTION

3.1 GENERAL:

A. Workmanship: Provide only first class workmanship from competent workers. Defective materials or workmanship will not be allowed on the project. Provide competent supervision for the work to be accomplished. Keep same foreman on the job, unless a change is authorized by the engineer.

B. Coordination: Prior to construction, layout electrical work and coordinate work with other trades. Sequence, coordinate, and integrate installation of materials and equipment for efficient flow of the work. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components. Coordinate with all utilities including power, communication, and data installations.

C. Provide cutting, drilling, channeling, etc. only as necessary for proper completion of the work. Do not cut structural members unless authorization is issued in writing by the architect/engineer.

D. Repairs: Repair damage to building, grounds, or utilities as a result of work under this contract at no additional cost to the owner.

E. Dimensioning: Electrical drawings indicate locations for electrical equipment only in their approximate location, unless specifically dimensioned. Do not scale electrical drawings for dimensional information. Refer to architectural drawings and shop drawings where applicable for locations of all electrical equipment. Field verify all dimension on the job site.

F. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this division.

G. Standards: Provide electrical installation in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

H. All workmen doing work of any nature on State of Utah projects must at all times carry their electrician's license with them and show it upon request. The acceptable ratio of apprentice to journeyman electricians on the job is 1:1.

3.2 REQUESTS FOR INFORMATION:

A. When it is clearly apparent that information is not adequately described in the construction documents or when a coordination problem exists, submit a request for information (RFI) through proper contractual channels. The electrical engineering design firm will provide a response through its contractual channel. Although verbal direction may be given to expedite changes, responses are not considered part of the contract documents until a change order has been issued and signed by the Owner or his designated representative. The Contractor shall bear all costs associated with proceeding on any change order that has not been approved by the Owner or his designated representative.

B. It is not the electrical engineering design firm's responsibility to answer questions that could clearly be answered by a thorough review of the construction documents. Should an RFI be issued by the Contractor where information was available, the electrical engineering firm will bill the contractor at the following rates:

1.	Principal	$125.00 / Hr.
2.	Engineer	$100.00 / Hr.
3.	Designer	$ 75.00 / Hr.
4.	Construction Administrator	$ 70.00 / HR.
5.	Drafting	$ 55.00 / Hr.
6.	Clerical	$ 40.00 / Hr.

C. Any damages caused by construction delays due to frivolous RFI's, will be born solely by the Contractor.

3.3 SAFETY PRECAUTIONS:

A. Provide all necessary guards or construction barriers and take all necessary precautions to insure the safety of life and property.

3.4 CLEAN:

A. Clean up all equipment, conduit, fittings, wire, packing cartons, plastic, and other debris that is a direct result of the installation of the work of this division. Keep the site clean and safe during the progress of the work. Clean fixtures, interior and exterior of all equipment, and raceways prior to final acceptance. Vacuum interior of all electrical panels and equipment. Correct any damaged equipment. Touch-up or repaint if necessary.

3.5 TEMPORARY POWER:

A. Make arrangements with the proper institution authority for all temporary electricity.

B. Provide temporary power, complete with metering and wiring for lighting and power outlets for construction tools and equipment. Report the initial meter reading to the owner/institution, or otherwise as may be directed.

C. Service shall be provided with a main disconnect and all 20 ampere receptacles protected by 20 amp GFI, single-pole breakers. No attempt is made herein to specify construction power requirements for equipment in detail...Provide all electrical equipment and wiring as required.

D. As soon as permanent power and metering is available, the temporary power supply shall be disconnected and removed from the project site.

E. All temporary wiring shall meet the requirements of NEC Article 305 and the State Industrial Commission.

3.6 POWER OUTAGES:

A. All power outages required for execution of this work shall occur during non-standard working hours and at the convenience of the owner. Any electrical service interruption will be coordinated at least 7 days in advance of the power shut-off. Include all costs for overtime work in bid. Coordinate all outages and proceed only after receiving authorization from the owner's representative. Keep all outages to an absolute minimum.

3.7 STORAGE AND PROTECTION OF MATERIALS:

A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. Lost or damaged materials will be replaced at no additional cost to owner. Do not store materials and apparatus in any public thoroughfare or in any area on the site where such storage would constitute a hazard to persons in the vicinity. Protect completed work, work underway, and apparatus against loss or damage.

3.8 EXCAVATING FOR ELECTRICAL WORK:

A. Verification: Prior to excavating, locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling. Observe all State and Local codes prior to excavating. Do not disturb walls, footings, and other structural members in any way.

B. Protection: Provide barricades, warning signs, and illumination to protect persons from injury at excavations. Provide temporary coverings and heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install electrical work on frozen excavation bases or subbases.

C. Coordination: Do not excavate for electrical work until the work is ready to proceed without delay.

D. Excavated Materials: Temporarily store excavated materials near excavation in manner which will not interfere with or damage excavation or other work. Dispose of and remove excavated materials which are either in excess of quantity needed for backfilling or do not comply with the requirements for backfill material.

E. Burial Depths: Burial depths must comply with NEC Section 300-5 (or State of Utah requirements, whichever is more stringent), unless noted otherwise on drawings.

3.9 BACKFILL MATERIALS:

A. For buried conduits or cables (other than below slab-on-grade, or concrete-encased), provide 2" thickness of well-graded sand on all sides of conduits or cables.

B. For trench backfill to within 6" of final grade, provide soil material suitable for compacting to required densities.

C. For top 6" of excavation, provide top soil.

D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment:

1. Lawn/Landscaped Areas: 85 percent for cohesive soils, 95 percent for cohesionless soils.
2. Paved Areas, other than roadways: 90 percent for cohesive soils, 95 percent for cohesionless soils.

E. Where subsidence is observable at electrical work excavations during project warranty period, remove surface, add backfill material, compact, and replace surface treatment. Restore surface to original condition.

3.10 ROOF PENETRATIONS:

A. Where raceways and/or cables penetrate roofing, provide 26 gauge galvanized iron roof jack, sized to fit tightly to raceway and/or cable for weather-tight seal, and with flange extending a minimum of 9" under roofing on all sides. Seal opening between raceway and roof jack with approved sealant. Coordinate all work with division 7.

3.11 FIRE PENETRATION SEALS:

A. Seal all raceway and/or cable penetrations through fire-rated floors, wall, and ceilings to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after fire. Provide penetration sealants and fittings of ratings to match the rating of the penetrated materials so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the NEC.

B. Sealant Systems: Provide sealants, wall wraps, partitions, caps, and other accessories complying with UL 1479 (ASTM E-814) from the following where applicable:

1. 3M Fire Barrier Sealing Penetration System
2. Chase Foam Fire Stop System
3. Thomas and Betts Flame Safe Fire Stop System
4. Nelson Fire Stop Products

C. Fittings: Where applicable, provide OZ Type CFSF/I and CAFSF/I fire seal fittings for conduit and cable penetrations through concrete and masonry wall, floor, slabs, and similar structures.

D. Install sealants and fittings in accordance with all manufacturer's written instructions.

3.12 LABELING:

A. Engraved black plastic laminated, with white-core labels, 1/16" thick, shall be permanently attached on both the interior and exterior the following electrical equipment:

1. Branch panels
2. Switchgear
3. Disconnect switches

4. Motor starter and controls junction boxes (power and auxiliary)
5. Push buttons
6. Thermal switches
7. Time switches
8. Motor control centers
9. Transformer
10. Similar equipment.
11. Lighting contactors and associated switches
12. Junction boxes larger than 4x4x1/2.

B. The labels shall have 1/4" high, engraved letters, such as EF-1, AC-1, Panel A, etc.

C. Label for motor starters and/or thermal overload switches shall include heater size and F.L.A.

D. Labels shall be red where serving emergency loads.

3.13 CONCRETE BASES:

A. Housekeeping Pads: Unless otherwise noted, provide 4" high reinforced concrete bases for all floor-mounted or floor-standing electrical equipment, including but not necessarily limited to the following:

1. Transformers
2. Switchgear
3. Generators
4. Battery racks
5. Similar Equipment

B. Extend bases 6" beyond equipment or mounting rails on all sides or as shown on the drawings. Not withstanding this requirement, coordinate with equipment manufacturer, shop drawings, and height of base to ensure compliance with NEC 380-82.

C. Concrete bases: Refer to Section 16551 – exterior area lighting.

3.14 TESTS:

A. Notify engineer prior to all testing specified herein. Engineer shall observe all tests to insure the proper operation of the electrical system.

3.15 PROJECT FINALIZATION AND START-UP:

A. Upon completion of the work, have each factory representative and/or subcontractor assist in start-up and testing of their respective systems.

B. Have each representative give personal instructions on operating and maintenance of their equipment to the owner's maintenance and/or operation personnel.

C. Have representatives certify each system with a written statement indicating that they have performed start-up and final check out of their respective systems.

3.16 FINAL REVIEW:

A. Have the project foreman accompany their reviewing parties and remove coverplates, panel covers, access panels, etc. as requested, to allow review of the entire electrical system.

END OF SECTION 16001

Camp Williams Readiness Center
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SECTION 16070 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to electrical connections.

1.2 DESCRIPTION OF WORK:

A. Extent of electrical connections for equipment include all final electrical connections for all equipment having electrical requirements including, but not necessarily limited to the following:

1. Equipment specified under all divisions of the contract. Refer to other divisions for specific electrical requirements.
2. Owner-furnished equipment
3. Kitchen Equipment
4. Etc.

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.

B. SHOP DRAWINGS: Not required.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide all materials for electrical connections including, but not necessarily limited to the following:

1. Raceways
2. Fittings
3. Conductors
4. Cords
5. Cord caps
6. Wiring devices
7. Pressure connectors
8. Lugs (CU-AL)
9. Electrical insulating tape
10. Heat-shrinkable tubing
11. Cable ties

12. Wire nuts
13. Other items and accessories as required.

B. Crimp on or slip-on type splicing materials designed to be used without wire stripping are not acceptable.

C. Power Distribution Blocks: Provide Square D Type LB or Equivalent.

D. Refer to other Division 16 Sections for specification of electrical materials as applicable.

PART 3 - EXECUTION

3.1 GENERAL:

A. Make electrical connections in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 CONNECTIONS:

A. Permanently Installed Fixed Equipment:

1. Install conductors in flexible conduit from junction box to equipment control panel or connection point.
2. Where such installations are subject to moisture, install in liquid-tight flexible conduit.

B. Movable equipment:

1. Provide wiring devices, cord caps, and multi-conductor cables as required.

C. Other methods as required by the NEC and/or as required by special equipment or field conditions.

D. Power Distribution Blocks: Unless noted otherwise on drawings, provide power distribution blocks only for tapping of feeders and branch circuits. Locate in junction box or gutter in NEMA ratings to suit application.

3.3 MANUFACTURER'S INSTRUCTIONS:

A. Obtain manufacturer's instruction and wiring diagram regarding electrical connections of each piece of equipment and provide connections in accordance therewith.

3.4 VERIFICATION OF LOAD CHARACTERISTICS:

A. Verify electrical load characteristics of all equipment prior to rough-in. Review respective shop drawings of all other Divisions and Owner's equipment manuals. Report any variances from electrical characteristics noted in the contract documents to the Architect/Engineer prior to rough-in.

B. Value of rough-in work, electrical equipment, etc. installed and/or purchased by the contractor not meeting equipment requirements shall be credited back to the owner.

END OF SECTION 16070

Camp Williams Readiness Center
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SECTION 16072 - ELECTRICAL SUPPORTS AND SEISMIC RESTRAINTS

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. Hangers and supports for electrical equipment and systems.
2. Seismic restraints for electrical equipment and systems.
3. Construction requirements for concrete bases.

1.3 DEFINITIONS:

A. Retain abbreviations and terms that remain after this Section has been edited.

B. IBC: International Building Code.

C. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.

1.4 SUBMITTALS:

A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support and seismic-restraint component used.

1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
2. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings: Indicate materials and dimensions and identify hardware, including attachment and anchorage devices, signed and sealed by a qualified professional engineer. Include the following:

1. Fabricated Supports: Representations of field-fabricated supports not detailed on Drawings.
2. Seismic Restraints: Detail anchorage and bracing not defined by details or charts on Drawings. Include the following:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Detail 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.
c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

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. Qualification Data: For professional engineer and testing agency.

F. Field quality-control test reports.

1.5 QUALITY ASSURANCE:

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Testing of Seismic Anchorage Devices: Comply with testing requirements in Part 3.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS:

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for

field assembly.

1. Available Manufacturers:
   a. Cooper B-Line; a division of Cooper Industries.
   b. ERICO International Corporation.
   c. Allied Support Systems; Power-Strut Unit.
   d. GS Metals Corp.
   e. Michigan Hanger Co., Inc.; O-Strut Div.
   f. National Pipe Hanger Corp.
   g. Thomas & Betts Corporation.
   h. Unistrut; Tyco International, Ltd.
   i. Wesanco, Inc.

2. Finishes:
   a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.

3. Channel Dimensions: Selected for structural loading and applicable seismic forces.

C. If retaining first paragraph below, coordinate with Part 3 and with Drawings to indicate where nonmetallic channel is to be used. Use where subject to corrosion.

D. Coordinate first subparagraph and list below with Part 2 "Manufacturers" Article. Retain "Available" for nonproprietary and delete for semiproprietary specifications.

E. Raceway and Cable Supports: As described in NECA 1.

F. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

G. 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.

H. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

I. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Verify suitability of fasteners in subparagraph below for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.

2. 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. Available Manufacturers:
      1) Hilti, Inc.
      2) ITW Construction Products.
      3) MKT Fastening, LLC.

4) Simpson Strong-Tie Co. Inc.

3. In the following subparagraph, use stainless steel anchors in corrosive environments.

4. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Available Manufacturers:
      1) Cooper B-Line; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc
      3) Hilti, Inc.
      4) ITW Construction Products.
      5) MKT Fastening, LLC.
      6) Powers Fasteners.

5. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

6. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

7. Toggle Bolts: All-steel springhead type.

8. Hanger Rods: Threaded steel.

2.3 SEISMIC-RESTRAINT COMPONENTS:

A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an agency acceptable to authorities having jurisdiction.

   1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.

B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.

C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.

   1. Available Manufacturers:
      a. Amber/Booth Company, Inc.
      b. Loos & Co., Inc.
      c. Mason Industries, Inc.

   2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.

   3. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod, of design recognized by an agency acceptable to authorities having jurisdiction.

4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.

5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

2.4 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 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.

B. Select option 2 of following subparagraph for DFCM Projects.

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for raceways as within 12 inches of coupling, fitting, and box, at each 90 degrees bend, minimum of two supports per ten foot run. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

D. Multiple Raceways: 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, or as otherwise required by an agency acceptable to authorities having jurisdiction.

3.2 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION:

A. Comply with NECA 1 for installation requirements, except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, raceways may be supported by openings through structure members, as permitted in NFPA 70.

C. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.

D. 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. Minimum static design load used for strength

determination shall be weight of supported components plus 200 lb (90 kg).

E. 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. To Existing Concrete: Expansion anchor fasteners.
5. 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 (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69] [Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. 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.

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

G. Do not drill or core cut holes for anchors or use powder-activated fastners in post-tension slabs, joists, and beams.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS:

A. Comply with installation requirements in Division 5 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. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and seismic criteria at Project.

B. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt diameters from edge of the base.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of the base.

2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3 Section "Cast-in-Place Concrete."

3.5 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS:

A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

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. Restraint Cables: Provide slack within maximums recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.6 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing: Test pullout resistance of seismic anchorage devices.

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Record test results.

END OF SECTION 16072

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16110 - CONDUIT RACEWAYS

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to conduit raceways.

1.2 DESCRIPTION OF WORK:

A. Extent of raceways is indicated by drawings and schedules.

B. Types of raceways in this section include the followings:

1. Rigid Metal Conduit
2. PVC Externally Coated Rigid Steel Conduit
3. Intermediate Metal Conduit
4. Electrical Metallic Tubing
5. Flexible Metal Conduit
6. Liquid-tight Flexible Metal Conduit
7. Rigid Non-metallic Conduit
8. Electrical Non-metallic Tubing

1.3 QUALITY ASSURANCE:

A. Standards: Refer to Section 16001 - Electrical General Provisions as applicable. Provide conduit raceway installation in accordance with recommendations of the American Iron and Steel Institute "Design Manual on Steel Electrical Raceways", latest edition.

B. Manufacturers: Firms regularly engaged in the manufacture of raceway of types and sizes required, whose products have been in satisfactory service for not less than three (3) years.

C. Shop Drawings: Not required.

PART 2 – PRODUCTS

2.1 CONDUITS:

A. Rigid Metal Conduit (RMC): Provide zinc-coated, hot-dipped galvanized, rigid metallic conduit in accordance with Federal Specification WW-C-0581 and ANSI C80.1.

B. PVC Externally Coated Rigid Metal Conduit: Provide hot-dipped galvanized, rigid metallic conduit externally coated with Polyvinyl Chloride (PVC) in accordance with ANSI C80.1 and NEMA Std. Pub. No. RN 1.

C. Intermediate Metal Conduit (IMC): Provide hot-dipped galvanized, intermediate metal conduit in accordance with Federal Specification WW-C-581.

D. Electric Metallic Tubing (EMT): Provide electric metal tubing in accordance with Federal Specification WW-C-563 and ANSI C80.3.

E. Flexible Metal Conduit: Provide zinc-coated, flexible metal conduit in accordance with Federal Specification WW-C-566.

F. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight, flexible metal conduit, constructed of single strip, flexible continuous, interlocked, and double-wrapped steel, galvanized inside and outside, coated with liquid-tight jacket of flexible Polyvinyl Chloride (PVC).

G. Rigid Non-Metallic Conduit: Provide rigid non-metallic conduit (PVC) in accordance with ANSI/NEMA TC 2, Type 1 for concrete encasement, Type 2 for direct burial.

2.2 FITTINGS:

A. Rigid Metal Conduit, Intermediate Metal Conduit, and PVC Externally Coated Rigid Metal Conduit: Provide fully-threaded, malleable steel fittings, rain-tight and concrete-tight as applicable. Provide double locknuts and metal bushings at all conduit terminations. Install OZ Type B bushings on conduits 1-1/4" and larger.

B. Electric Metallic Tubing: Provide insulated throat, non-indenter, set screw, malleable steel fittings. Screws must have a full set. Provide concrete-tight compression-type fittings in suspended slabs. All EMT fittings shall be fabricated from steel. Die-cast fittings or fittings made from pot metal shall not be allowed. Indenter type fittings are not acceptable. Install OZ Type B bushings on conduits 1" and larger.

C. Flexible Metal Conduit: Provide flexible metal conduit fittings in accordance with Federal Specification W-F-406, Type 1, Class 1, and Style A. Commercial "greenfield" not less than 1/2" diameter or as otherwise specified on drawings is acceptable.

D. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit fittings in accordance with Federal Specification W-F-406, Type 1, Class 3, Style G.

E. Non-Metallic Conduit: Provide non-metallic conduit fittings (PVC) in accordance with ANSI/NEMA TC 3 to match conduit types and materials.

F. Expansion Fittings: OZ Type AX, or equivalent to suit application.

G. Sealing Bushings: Provide OZ Type FSK, WSK, or CSMI as required by application. Provide OZ Type CSB internal sealing bushings.

H. Cable Supports: Provide OZ cable supports for vertical risers, type as required by application.

2.3 SIZES:

A. Provide conduits in sizes as indicated in contract documents or as otherwise specified herein, but not less than 3/4".

PART 3 - EXECUTION

3.1 GENERAL:

A. Install raceway and accessories in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 LOCATIONS:

A. Rigid Metal Conduit and Fittings: Use for conduit bends greater than 22 degrees where buried below grade or slab on grade. Install RMC where raceway passes vertically through slab-on-grade. Where raceways penetrate building, manholes, or vault walls and floors below grade, provide RMC for a minimum distance of 10' on the exterior side of the floor or wall. Use RMC for exposed runs where conduit is subject to moisture, weather, or mechanical injury. Use in hazardous locations in accordance with all NEC requirements.

B. Intermediate Metal Conduit and Fittings: Use for exposed runs where conduit is subject to moisture, weather, or mechanical injury. Use in hazardous locations in accordance with all NEC requirements.

C. Electric Metal Tubing and Fittings: Use for above-grade feeders, branch circuits, and signal and control circuit, unless specifically noted otherwise on drawings. Install in suspended slabs subject to local code requirements and fire rating considerations.

D. Flexible Metal Conduit and Fittings: Use as whips for lighting fixtures, fixed equipment where not exposed to weather of moisture, other devices where required by NEC, and as requested by the Engineer. Maximum length not to exceed 6', unless specified otherwise.

E. Liquid-Tight Flexible Metal Conduit and Fittings: Use for connection to motor terminal boxes, fixed equipment where subject to moisture or weather, and other equipment subject to movement or vibration. Maximum length not to exceed 6', unless specified otherwise.

F. Rigid Non-Metallic Conduit and Fittings: Use for below-grade service entrances, feeders, branch circuits, and signal and control circuit, unless specifically noted otherwise on drawings. Do not use above grade.

3.3 METHODS:

A. Maintain a minimum of 12" clearance between steam or hot water lines or other hot surfaces. Where such clearance is impractical, insulate conduit with approved materials.

B. Install conduits parallel with or at right angles to lines of the structure. Route conduits symmetrically where possible.

C. Field bends and offsets shall be made without flattening, kinking, rippling or destroying the smooth internal bore or surface of the conduit and to not less than NEC minimum radius. Conduit that shows signs of rippling or kinking shall not be installed. Conduits installed with wrinkles or kinks or otherwise in an unworkmanlike manner shall be replaced at no

additional cost to owner.

D. Precaution shall be exercised to prevent accumulation of water, dirt or concrete in the conduits during the execution of the project. Conduits in which water or foreign matter has been permitted to accumulate shall be thoroughly cleaned or the conduits runs replaced where such accumulation cannot be removed by methods approved the engineer.

E. Any conduit which pierces airtight spaces or plenums shall be sealed to prevent air leakage with mastic acceptable to the Architect.

3.4 CONCEALING:

A. All raceways shall be concealed within the ceilings, walls, and floors, except in locations where exposed raceways are specifically permitted, such as equipment rooms and unfinished storage areas. In equipment rooms, if lighting raceways are run exposed, installation shall not be done until piping and duct work layout has been determined in order that lighting boxes may be located so as to avoid being covered by overhead ducts and piping. If lighting raceways in equipment rooms are concealed in the structural ceiling slab, after mechanical work is complete, exposed conduit extensions shall be run to locate lighting fixtures where they are not obscured by work of other trades.

3.5 BURIED CONDUITS:

A. Comply with all burial depths as defined in NEC Section 300-5. Bury all conduits at least 24" below grade, unless specifically indicated otherwise on drawings. Provide magnetic 6" wide "Yellow Warning" ribbon 12" directly above conduit and 6" below finished grade measured from the top of the conduit or duct bank. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single marker.

B. Slope all conduits toward manholes or pull boxes for proper drainage. Use weep holes. Gravel drainage pockets are not permitted.

C. Coat all metal conduits with an approved asphaltic compound or wrap with two layers of PVC tape.

D. Under Concrete Slab on Grade: Horizontal conduit must be installed a minimum of 2" below the bottom of the concrete slab. Conduits should not be installed in concrete slabs.

E. Concrete Encasement: Where concrete-encasement is indicated on drawings, provide ductbank construction using red 3000 psi at 28 day strength concrete. Provide minimum 4" cover on all sides of exterior conduits. Provide conduit spacers where applicable.

F. Where conduits are extended for future use, cap and clearly mark.

3.6 ELECTRICAL CONTINUITY:

A. Provide electrically continuous conduit systems throughout.

3.7 FIELD CUTS AND THREADS:

A. Cut all conduits square. Remove all sharp or rough edges and ream all burrs, inside and outside. Provide clean sharp threads on RMC and IMC.

B. Engage at least five full threads on all RMC and IMC fittings. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of RMC or IMC. Apply coat of red lead, zinc chromate or special compound recommended by manufacture to conduit where conduit protective coating is damaged.

3.8 SUSPENDED SLABS:

A. When conduit is installed in the suspended slab, it shall be limited to conduits having a diameter of 1" (25 mm) or less, or less than 1/3 the concrete cover, and no crossovers occur, and conduit spaced at least 18" (450 mm) apart with a 3/4" (20 mm) cover.

3.9 CONDUIT ENDS:

A. Cap all spare conduits. Cap or plug conduit ends during construction to prevent entrance of foreign material.

3.10 SPARE CONDUITS:

A. Provide five (5) 3/4" empty conduits from panel stubbed into accessible ceiling space and five (5) 3/4" conduits into accessible floor space. When floor is not accessible, provide six (6) 3/4" empty conduits from panel stubbed into accessible ceiling space. Cap and label all conduits.

B. Install a 200 lb. polypropylene pull cord in each empty conduit run.

3.11 HAZARDOUS LOCATIONS:

A. Install RMC and IMC in all hazardous locations as defined by the NEC. Provide suitable fittings, seal-offs, boxes, etc. to comply with all NEC requirements and/or as shown on the drawings. Provide inspection fittings with hazardous location rated drains to prevent water from accumulating in conduit runs.

3.12 CLEANING:

A. Pull mandril and swab through all conduit before installing conductors.

END OF SECTION 16110

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16111 - RACEWAY 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 work of this section.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to raceway systems.

1.2 DESCRIPTION OF WORK:

A. Extent of raceway systems is indicated by drawings and schedules.

B. Types of raceway systems in this section include the following:

1. Cable Tray

1.3 QUALITY ASSURANCE:

A. Standards: Refer to Section 16001 - Electrical General Provisions as applicable. Cable tray shall meet all the requirements of NEMA VE-1.

B. Shop Drawings: Submit dimensioned drawings and manufacturer's data of raceway systems showing layout of raceways and fittings and spatial relationships to associated equipment.

PART 2 - PRODUCTS

2.1 CABLE TRAY SYSTEMS:

A. General: Provide UL-listed cable tray systems of sizes and types indicated. Provide ladder type cable tray, 12" wide, 4" high, 12" rung spacing, NEMA class 12A, and aluminum.

B. Fittings and accessories: Provide all fittings and accessories as required for a complete system. Provide bends having radii of 12", intersections, expansion joints, transition fittings, reducers, barrier strips, conduit-to-tray clamps, hangers, supports, retaining clips, etc.

C. Supports: Provide center hung tray support systems. Provide support systems including lateral and longitudinal bracing to meet the requirements of Section 16136 - Supporting Devices.

D. Grounding: Provide cable tray systems that are completely continuous.

E . Manufacturers: Subject to compliance with requirements, provide cable tray systems of one of the following:

B-Line
P/W Industries
Globe Metal Products
Square D
Thomas&Betts
T.J. Cope

PART 3 – EXECUTION

3.1 GENERAL:

A. Install raceway systems and accessories in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 CABLE TRAYS:

A. Grind all rough edges, drip concentrations, etc. to a smooth finish. Apply cold zinc spray to all field cut surfaces.

END OF SECTION 16111

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16120 - CONDUCTORS AND CABLES

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to conductors and cables.

1.2 DESCRIPTION OF WORK:

A. This section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

B. Types of conductors and cables in this section include the following:

1. Copper Conductors.
2. Flexible Cords.

C. Applications for conductors and cables required for project include:

1. Electrical service.
2. Feeders.
3. Branch Circuits.

1.3 SUBMITTALS:

A. Product Data: For each type of conductor and/or cable indicated.

B. Field Quality-Control Test Reports: From Contractor. Refer to Section 16000 – General Electrical Provisions.

1.4 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 GENERAL:

A. Manufacturers: In other Part 2 articles where subparagraph titles below introduce lists, provide

products by the manufacturer specified, subject to compliance with requirements.

B. Ambient Conditions: Conductors used for branch circuits in areas where the ambient conditions exceed 30 degree C. shall be provided with insulation approved for that temperature.

C. Wire Sizes: As indicated on electrical drawings or as specified herein, but in no case less than No. 12 AWG.

2.2 COPPER CONDUCTORS:

A. Manufacturers:

1. American Insulated Wire Corporation; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. Refer to Part 3 "Conductor and Cable Applications" Article for application requirements.

C. References and Ratings:

1. ICEA S-95-658 / NEMA WC70.
2. ASTM.
3. UL Standard 83.
4. UL Standard 1063 (MTW).
5. Federal Specification J-C-30B.
6. NEC.

D. Conductor Material: Copper.

E. Stranding: Solid conductor for No. 12 AWG, stranded for No. 10 AWG and larger.

F. Conductor Insulation Types: Thermoplastic-insulated, Type THHN / THWN-2.

2.5 CONNECTORS AND SPLICES:

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install conductors, cables, and accessories as indicated, in compliance with manufacturer's written instruction, applicable requirements of NEC, NECA's "Standards of Installation", and in accordance with recognized industry practices to ensure that products fulfill requirements.

3.2 CONDUCTOR AND CABLE APPLICATIONS:

A. Service Entrance: As indicated on the electrical drawings.

B. Feeders: As indicated on the electrical drawings.

C. Branch Circuits:

1. Exposed, including in crawlspaces: Copper conductors in raceway.
2. Concealed in ceilings, walls, and partitions: Copper conductors in raceways.
3. Concealed in concrete and below slabs-on-grade: Copper conductors in raceway.

D. Cord Drops, Reels, and Portable Appliance Connections: Flexible cord.

E. Class 1 Control Circuits: Copper conductors in raceway.

3.2 INSTALLATION:

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. When raceway is not required, install concealed cables parallel and perpendicular to surfaces of structural members, and follow surface contours where possible.

E. Support cables according to other applicable specification sections.

F. Seal around cables penetrating fire-rated elements to comply with applicable fire stop specification sections.

G. Color Coding: Color code secondary service, feeder, and branch circuit conductors. Colors shall remain consistent throughout the project and shall match existing coding system where applicable.

1. Conductor sizes No. 6 AWG and smaller: Colored insulation.
2. Conductors sizes No. 4 AWG and larger: 2 inch (51 mm) band of Colored adhesive

marking tape applied at all terminations, junction boxes, and pull boxes.

3. Branch circuit switched-legs and travelers: Colored insulation (in colors other than those indicated below).
4. Color-code 120/208V system conductors:
   a) Phase A: Black.
   b) Phase B: Red.
   c) Phase C: Blue.
   d) Neutral: White.
   e) Ground: Green.
   f) Isolated Ground: Green with yellow tracer.

3.3 HOMERUN CIRCUITS:

A. Homerun circuits may be combined in common conduits at the option of the contractor in compliance with the following:

1. Three-Phase Installations: Not more than three single-phase circuits with common neutral in one conduit, unless specifically noted otherwise, if each circuit is from a different phase (a, b, or c).
2. Single-Phase Installations: Not more than two single-phase circuits with common neutral in one conduit, unless specifically noted otherwise, if each circuit is from a different phase (a or b).

3.4 NEUTRAL CONDUCTORS:

A. LIGHTING CIRCUITS: Where multiple circuits serving lighting are run in a single raceway (see paragraph above for allowable number or circuits per conduit), a common neutral shall be allowed. When any one circuit is serving fluorescent lighting loads, provide an oversized neutral conductor. Size the neutral conductor one size (AWG) larger than the largest phase conductor.

B. OUTLET CIRCUITS: Where multiple circuits serving electrical outlets are run in a single raceway (see paragraph above for allowable number of circuits per conduit), a separate neutral shall be included for each circuit. In each outlet or junction box containing multiple neutrals, each neutral shall be tagged to identify which circuit it serves.

3.6 SYSTEM FURNITURE CIRCUITS:

A. Coordinate system furniture wiring requirements and termination locations with supplier/installer prior to rough-in. Coordinate placement of connection boxes in walls and columns (where applicable) to insure that adequate accessibility is maintained.

B. 4-Circuit, 3+D Wiring: Provide a total of 8 conductors to each system furniture connection consisting of three circuits with shared equipment ground and shared oversized neutral; and one dedicated circuit with dedicated isolated ground and dedicated neutral. Size the shared neutral conductor one size (AWG) larger than the largest phase conductor.

3.7 VOLTAGE DROP:

A. Provide branch circuit conductors in sizes such that voltage drop for branch circuits do not exceed 3 percent at the farthest outlet. Provide service, feeder, and branch circuit conductors so that the voltage drop on the entire electrical system does not exceed 5

percent at the farthest outlet. This shall be strictly followed regardless of the conductor sizes indicated on the electrical drawings. Increase conductor sizes (and conduits where necessary to comply with NEC conduit fill requirements) as necessary to accommodate this requirement. Calculations shall be based on the following:

1. Lighting Branch Circuits: Connected load plus 25% spare.
2. Appliance and Equipment Branch Circuits: Nameplate or NEC required load.
3. Convenience Outlet Branch Circuits: 12 amps minimum, but in no case less than NEC loading requirements. Use the following schedule:

Distance (feet)	Wire Size (AWG)
0-70	#12
71-115	#10
116-180	#8
181-290	#6

4. Use the NEC method to calculate voltage drop.

3.8 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 6 inches (150 mm) of slack. Use pig tails when wiring outlets.

D. Stranded Conductors: Stranded conductors shall not be connected to electrical devices. A 6" pig tail or a crimp-on spade connector shall be installed.

3.9 FIELD QUALITY CONTROL:

A. Testing: Perform the following field quality-control testing:

1. Visual and Mechanical Inspection:
   a) Inspect cables for physical damage and proper connection in accordance with the electrical construction documents.
   b) Test cable mechanical connections to manufacturer's recommended values with a calibrated torque wrench.
   c) Check cable color coding for compliance with electrical specifications.
2. Electrical Tests:
   a) Perform insulation resistance test on each conductors for feeders 100 amps and greater with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.
   b) Perform continuity test to insure proper cable connection.
3. Test Values:
   a) Minimum insulation resistance values shall not be less than two megohms.

B. Test Reports: Prepare a written report and submit to the Electrical Engineer at the completion of the project. The report shall include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 16120

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16124 - MEDIUM-VOLTAGE CABLES

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to medium-voltage cables.

1.2 SUMMARY:

A. This Section includes cables and related splices, terminations, and accessories for medium-voltage electrical distribution systems.

1.3 SUBMITTALS:

A. Product Data: For each type of cable indicated. Include splices and terminations for cables and cable accessories.

B. Samples: 16-inch (400-mm) lengths of each type of cable indicated.

C. Qualification Data: For testing agency.

D. Source quality-control test reports.

E. Material Certificates: For each cable and accessory type, signed by manufacturers, certifying that cables comply with requirements specified in Part 2 Article "Source Quality Control."

F. Field quality-control test reports.

1.4 QUALITY ASSURANCE:

A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.

B. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise testing specified in Part 3.

C. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.

D. 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.

E . Comply with IEEE C2 and NFPA 70.

1.5 PROJECT CONDITIONS:

A . 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 at least two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A . Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cables:
   a) American Insulated Wire Corp.; a Leviton Company.
   b) BICC Brand-Rex Company.
   c) General Cable Corporation.
   d) Kerite Co. (The); Hubbell Incorporated.
   e) Okonite Company (The).
   f) Pirelli Cables & Systems NA.
   g) Rome Cable Corporation.
   h) Southwire Company.
2. Cable Splicing and Terminating Products and Accessories:
   a) G&W Electric Co.
   b) Raychem Corp.; Telephone Energy and Industrial Division.
   c) RTE Components; Cooper Power Systems, Inc.
   d) Thomas & Betts/Elastimold.
   e) 3M Company; Electrical Products Division.

2.2 CABLES:

A . Cable Type: MV-90.

B . Conductor: Copper.

C . Conductor Stranding: Compact round, concentric lay, Class B.

D . Strand Filling: Conductor interstices are filled with impermeable compound.

E . Conductor Insulation: Ethylene-propylene rubber complying with AEIC CS 6 and NEMA WC 8

1. Voltage Rating: 15 kV.
2. Insulation Thickness: 133 percent insulation level.

F. Shielding: Copper tape, helically applied over semiconducting insulation shield.

G. Cable Jacket: Sunlight-resistant PVC.

2.3 SPLICE KITS:

A. Connectors and Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for the application.

B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.

1. Combination tape and cold-shrink-rubber sleeve kit with rejacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.
2. Heat-shrink splicing kit of uniform, cross-section, polymeric construction with outer heat-shrink jacket.
3. Premolded, cold-shrink-rubber, in-line splicing kit.
4. Premolded EPDM splicing body kit with cable joint sealed by interference fit of mating parts and cable.

2.4 SOLID TERMINATIONS:

A. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone rubber, insulator modules; shield ground strap; and compression-type connector.

2.5 ARC-PROOFING MATERIALS:

A. Tape for First Course on Metal Objects: 10-mil- (250-micrometer-) thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.

2.6 SOURCE QUALITY CONTROL:

A. Test and inspect cables according to NEMA WC 8 before shipping.

B. Each reel of cable shall be newly manufactured (no more than 12 months old), and shall bear a tag containing name of manufacturer and the date it was manufactured.

C. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig (35 kPa).

PART 3 – EXECUTION

3.1 INSTALLATION:

A. Install cables according to IEEE 576.

B. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

1. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.
2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.

C. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag.

D. Install cable splices at pull points and elsewhere as indicated; use standard kits.

E. Install terminations at ends of conductors.

F. Install separable insulated-connector components as follows:

1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
2. Portable Feed-Through Accessory: Three.
3. Standoff Insulator: Three.

G. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:

1. Clean cable sheath.
2. Wrap metallic cable components with 10-mil (250-micrometer) pipe-wrapping tape.
3. Smooth surface contours with electrical insulation putty.
4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
5. Band arc-proofing tape with 1-inch- (25-mm-) wide bands of half-lapped, adhesive, glass-cloth tape 2 inches (50 mm) o.c.

H. Seal around cables passing through fire-rated elements according to applicable firestop specifications.

I. Install fault indicators on each phase conductor leaving a manhole or transformer vault.

J. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

K. Color Coding: Provide color and coding of conductors by minimum 12" band of colored tape on black insulation, as follows:

A-Phase	Black
B-Phase	Red
C-Phase	Orange
Neutral	White
Ground	Green

3.2 FIELD QUALITY CONTROL:

A. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

1. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.2. Testing shall include, but is not necessary limited to shield continuity test, insulation resistance test, and a dc high potential test. Certify compliance with test parameters.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 16124

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16135 - ELECTRICAL BOXES AND FITTINGS

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to electrical boxes and fittings.

1.2 DESCRIPTION OF WORK:

A. Extent of electrical boxes and fittings work is indicated by drawings and schedules.

B. Types of electrical boxes and fittings in this section include the following:

1. Outlet Boxes
2. Junction Boxes
3. Pull Boxes
4. Floor Boxes
5. Conduit Bodies
6. Bushings
7. Locknuts
8. Knockout Closures
9. Miscellaneous Boxes and Fittings

1.3 QUALITY ASSURANCE:

A. Standards: Refer to Section 16001 - Electrical General Provisions as applicable.

B. Manufacturers: Firms regularly engaged in the manufacturer of boxes and fittings required, whose products have been in satisfactory service for not less than three years.

C. Shop Drawings: Submit shop drawings on floor boxes only where required.

PART 2 - PRODUCTS

2.1 INTERIOR OUTLET BOXES:

A. General: Provide one piece, galvanized or cadmium-plated, flat-rolled, sheet steel interior outlet boxes of types, shapes, and sizes to suit respective location and installation. Construct with stamped knockouts on back and sides and with threaded screw holes. Provide corrosion-resistant screws for securing boxes, covers, and wiring devices. Size all junction boxes in accordance with NEC Table 370-16(a), with a minimum box size of 4" x 4" x 1-1/2". Where three raceway entries are made, provide outlet boxes with a minimum depth of 2-1/8". Where four or more raceway entries are made, provide outlet boxes with

a minimum depth of 4-11/16". Gangable boxes shall not be used.

B . Switch, Telephone, and Receptacle Outlets: Provide outlet boxes not less than 4" square, with adapting tile or plaster covers where necessary to set flush with finished surfaces. Where three raceway entries are made, provide outlet boxes with a minimum depth of 2-1/8". Gang boxes shall be used where more than one switch or device is located at one point. Sectional Boxes are not acceptable. In masonry walls where tile or plaster ring cannot be used, install a single-gang 3-1/2" deep box minimum, unless otherwise noted. Where four or more raceway entries are made, provide outlet boxes with a minimum depth of 4-11/16".

C . Lighting Outlets:

1. Lay-in Grid: Outlets for recessed fixtures in acoustical tile ceilings shall be located to center on a single tile or at the intersection of four tiles.
2. Surface-mounted: Provide 4" square octagonal outlet boxes for surface-mounted, ceiling fixture outlets. Mount each box independently of the conduit on standard 3/8" stud or approved box hangar where applicable. Include backing and supports as required to carry 200 lbs. Where three or more raceway entrances are made, use a minimum box depth of 2-1/8".

2.2 WEATHERPROOF OUTLET BOXES:

A . Provide corrosion-resistant, cast-metal weatherproof outlet boxes, of types, shapes, and sizes, with threaded conduit ends, cast metal coverplates with spring-hinged waterproof caps, face plate gaskets, and corrosion-resistant fasteners.

2.3 JUNCTION AND PULL BOXES:

A . Provide code-gauge sheet steel junction and pull boxes, with removable screw-on covers and welded seams, of types, shapes, and sizes to suit each respective location and installation. Size all junction and pull boxes in accordance with NEC 370-28. Provide stainless steel nuts, bolts, screws, and washer.

2.4 FLOOR BOXES:

A . Provide steel or PVC, weatherproof, concrete-tight floor boxes of types, shapes, and sizes to suit each respective location and installation. Where multi-service floor boxes are indicated, provide floor boxes sized to accommodate wiring devices and communication outlets shown on drawings. Construct floor boxes with fully adjustable leveling screws, and knockouts as required to accommodate specified conduits.

B . Provide floor boxes from the following manufacturers:

1. Bell Electric
2. Crouse-Hinds
3. Hubbell
4. Steel City
5. Thomas&Betts
6. Wiremold

2.5 CONDUIT BODIES:

A. Provide galvanized, cast-metal conduit bodies of type, shapes, and sizes to suit respective locations and installation. Construct with threaded conduit entrance ends and removable covers. Provide corrosion-resistant screws.

B. Aluminum boxes and fitting shall not be permitted.

2.6 CONDUIT CONNECTIONS:

A. Box connectors 3/4" and larger shall be insulated, throat-type or equal type plastic bushings. Provide double locknuts and insulating plastic bushings for RMC and IMC terminating at panels and boxes. Also see Section 16135 – Electrical Boxes and Fittings.

B. Where RMC penetrates building, manholes, or vault walls and floors below grade, provide sealing bushings with external membrane clamps as applicable. Provide segmented internal sealing bushings in all raceways penetrating building walls and slabs below grade, and in all above grade raceway penetrations susceptible to moisture migration into building through raceway. Where RMC terminates in manhole, vault, or pull box, provide insulated grounding bushings. Also see Section 16135 – Electrical Boxes and Fittings.

C. Install OZ type "B" connectors for all conduits 1" and larger.

D. Provide cable supports in all vertical risers in accordance with NEC 300-19.

2.7 EXPANSION FITTINGS:

A. Provide expansion joint fittings in all conduit runs crossing structural expansion joints, whether above-grade, in slab-on-grade, or in suspended slabs. Provide OZ type "AX" or approved equivalent, size to the raceway.

2.8 ACCESSORIES:

A. Provide all accessories including, but not necessarily limited to, bushings, knockout closures, locknuts, offset connectors, etc. of types, shapes, and sizes to suit respective locations and installation. Construct of corrosion-resistant steel.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install electrical boxes and fittings in accordance with manufacturer's written instruction, applicable requirements of the NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 METHODS:

A. Where outlet boxes are subject to weather or moisture, install weatherproof outlet boxes.

B. Remove knockouts only for entering conduits. Provide knockout closures to cap unused knockout holes where blanks are mistakenly removed.

C. Do not use condulets in place of elbows or junction boxes. Condulets in sizes 2" or larger shall not be used, unless specifically approved by the electrical engineer.

D. Install boxes and conduit bodies in readily accessible locations. Install recessed boxes with faces of boxes or rings flush with finished surfaces. Seal all openings between outlet box and adjacent surfaces with plaster, grout, or similar suitable material.

E. For stud construction, install boxes with rigid supports using metal bar hangers, or 2" X 4", 1" X 6" wood bridging between studs with screws. Welding or nailing boxes directly to metal joist and studs is not acceptable. Boxes set opposite in common wall shall have at least 10" of conduit between them. Securely fasten outlet boxes to structural surfaces to which attached.

F. For concrete or masonry construction, solidly embed electrical boxes in concrete and masonry. Provide box supports as required to keep outlet boxes flush with finished surfaces.

G. Coordinate location of all outlet boxes with millwork, back splashes, tackboards, etc.

H. Install junction boxes or condulets in conduit runs as required at 100 foot maximum intervals on long runs. This shall apply to concrete junction boxes in grade and junction boxes within the building.

I. Provide electrical connections for installed boxes.

3.3 IDENTIFICATION:

A. Mark circuit number on exterior side of junction boxes located in ceilings such that circuits numbers are readily identifiable. For outlet boxes in wall, mark circuit numbers on interior sides of outlet boxes.

B. Identification labels shall be as follows:

Normal Power	Black with White letters
Emergency Power	Red with White Letters

END OF SECTION 16135

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16140 - WIRING DEVICES

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to wiring devices.

1.2 DESCRIPTION OF WORK:

A. Extent of wiring device work is indicated by drawings and schedules.

B. Types of electrical wiring devices in this section include the following:

1. Toggle Switches
2. Receptacles
3. Floor Service Outlets
4. Poke-Through Assemblies
5. Dimmers
6. Special Purpose Outlets
7. Multioutlet Assemblies
8. Cord Caps and Connectors
9. Occupancy Sensors

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.

B. SHOP DRAWINGS: Submit manufacturer's data on all electrical wiring devices.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide factory-fabricated wiring devices, in types, and electrical ratings for applications indicated and complying with NEMA standards Pub No. WD 1. nylon construction, 20 amp rating minimum.

B. Provide wiring devices in colors selected by Architect/Engineer. Where convenience outlet duplex receptacles are circuited to emergency power, provide red devices.

2.2 TOGGLE SWITCHES:

A. Provide toggle switches from one of the following manufacturers (Fed-Spec):

Manufacturer	1-Pole	3-Way	4-Way	W/Pilot
Hubbell	HBL1221	1223	1224	1221-PL
Pass & Seymour	20AC1	20AC3	20AC4	20AC1-RPL
Leviton	1221	1222	1223	1221-PLR
GE	5951	5953	5954	SP121
Eagle	2221	2223	2224	2221-PL
Bryant	4901	4903	4904	4901-PL

B. Abbreviations are defined as follows:

1. 1-Pole - Single-Pole Toggle Switch
2. 3-Way - Three-Way Toggle Switch
3. 4-Way - Four-Way Toggle Switch
4. W/Pilo - Single-Pole Toggle Switch with Pilot Light

C. Must be back and side wired, and have color-coded covers, Brass terminal screws, back wire ground clamp, and self-grounding clip.

2.3 RECEPTACLES:

A. Provide duplex receptacles from one of the following manufacturers:

Manufacturer	CO	GFCI	IG
Hubbell	5362	GF53625362IG	
Pass & Seymour	5362	2091-S	IG6300
Leviton	5362	8899	5362-IG
GE	5362	GFR5362	5362IG
Eagle	5362	647-2	IG5362
Bryant	5362	GFR53FT	5362IG

B. Abbreviations are defined as follows:

1. CO- Convenience Outlet Duplex Receptacle
2. GFCI- Ground Fault Circuit Interrupter duplex Receptacle
3. IG- Isolated Ground Duplex Receptacle

C. Must have one-piece Brass back strap and back wire grounding clamp (Does not apply to GCFI or isolated ground).

2.4 FLOOR SERVICE OUTLETS:

A. Provide all receptacles and special purpose outlets required in floor boxes. See Section 16135 - Electrical Boxes and Fittings. Provide coverplates, carpet flanges, etc. in finishes or colors selected by Architect/Engineer.

2.5 POKE-THROUGH ASSEMBLIES:

A. Provide factory-assembled, poke-through assemblies equipped with wiring devices as specified herein. Construct of materials to maintain fire rating of suspended slab with pre-wired conduit, fire barriers, toggle arm assemblies, service fittings, integral junction box, etc. Provide coverplates, carpet flanges, etc. in finishes or colors selected by Architect/Engineer. Provide Poke-through assemblies of one of the following:

1. Hubbell
2. RCI
3. Thomas&Betts
4. Wiremold

2.6 DIMMERS:

A. Incandescent: Provide solid state, linear slide preset dimmers of voltage and wattage ratings to suit respective application. Provide dimmers that are UL listed for required loads (i.e., incandescent, magnetic low voltage transformer, electronic low voltage transformer). Where applicable, insure that dimmers are compatible with lamps and ballasts provided. Provide dimmers from one of the following:

1. Lutron (Nova T Series)
2. Prescolite (Horizon Series)
3. Lightolier (Neptune Momentum Series)
4. Leviton (IllumaTech Series)

B. Fluorescent: Provide single-pole, AC dimmers for fluorescent fixtures, 60 hertz, 120 or 277 volt as applicable, with slide-to-off continuously adjustable slider control. Construct with continuously adjustable trim potentiometer for adjustment of low end dimming. Dimmers to be an integral part of a fluorescent dimming system consisting of dimming ballast and lighting controls made by the same manufacturer. Refer to Section 16510 - Interior and Exterior Lighting Systems. Provide dimmers from one of the following:

1. Lutron (Nova T Series)
2. Leviton (IllumaTech Series)

2.7 SPECIAL PURPOSE OUTLETS:

A. Provide special purpose outlets of voltage and ampere ratings, and NEMA configurations to suit respective application. Refer to drawings for NEMA configuration. Provide special purpose outlets in amperages at least as large as the overcurrent protective device from which they are served.

2.8 MULTI-OUTLET ASSEMBLIES:

A. Provide multi-outlet assemblies with 15A, grounding-type, receptacle outlets spaced at 6" on centers and in colors selected by Architect/Engineer or as otherwise noted on drawings. Provide multi-outlet assemblies of one of the following:

1. Wiremold
2. Thomas&Betts
3. Hubbell

2.9 CORD CAPS AND CONNECTORS:

A. Provide cord caps and connectors of voltage and ampere ratings, and NEMA configurations which mate and match with outlets specified as required for final connections for equipment. Provide cord caps and connectors of one of the following:

1. Hubbell
2. Pass & Seymour
3. Leviton
4. Eagle
5. Bryant

2.10 COVERPLATES:

A. Wall Plates: Provide coverplates for all wiring devices. In all finished areas, provide nylon or high impact resistant thermoplastic coverplates in colors to match wiring devices and/or special purpose outlets. Provide ganged coverplates for all switches and/or dimmers. Provide pre-marked coverplates for special purpose outlet indicating voltage, amperages, and phase. Provide raised stamped, galvanized, steel plates in all unfinished areas. Provide weather-proof coverplates for outlets exposed to weather and moisture.

B. Weather-Protecting Device Enclosure: Where required for compliance with NEC 410-67 (receptacles installed outdoors for use other than with portable tools or equipment), provide weather-tight device covers which provide complete protection with the cord and cap inserted into the wring device. Provide units which mount on either single or double gang devices. Provide device enclosures manufactured by one of the following:

1. Intermatic WP1020 or WP1030
2. Hubbell WP826MP
3. Pass & Seymore

2.11 OCCUPANCY SENSORS:

A. General: Provide self-contained, ultrasonic motion detectors providing volumetric coverage without gaps within the detection area. Provide sensors in voltage and wattage ratings required to suit application. Provide sensors from one of the following manufacturers:

1. Lithonia
2. Novitas
3. The Watt Stopper
4. Hubbell
5. Leviton

B. Occupancy sensors specified on drawings are manufactured by the Watt Stopper. The manufacturers indicated above are acceptable provided that they meet the functional performance of those specified. Prior approval for these manufacturers is not required; however, if it is determined that the proposed occupancy sensors do not meet functional performance of the specified occupancy sensors, the Contractor shall provide the specified occupancy sensors at no additional cost to Owner.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install wiring devices and accessories in accordance with manufacturer's written instruction, applicable requirements of the NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to insure that products fulfill requirements.

3.2 METHODS:

A. Install wiring devices only in electrical boxes which are clean and free from excess building materials, dirt, and debris. Do not install wiring devices until painting work is completed.

B. Replace receptacles and/or coverplates which are damaged, stained, or burned.

3.3 GFCI RECEPTACLES:

A. Provide separate neutral conductor from panel to each GFCI receptacle.

B. Install GFCI receptacles for all receptacles installed in restrooms, outdoors, or within six feet of any sink. All receptacles in kitchens shall be GCFI protected.

C. Do not wire standard receptacles in series with GFCI receptacle - Install GFCI receptacles. GCFI receptacles should be installed with no down stream receptacles being protected from the GCFI receptacles.

3.4 DIMMERS:

A. Provide separate neutral conductor for each phase of the branch circuit on which dimmers are installed.

B. Provide dimmers in wattage ratings that will support the maximum potential wattage of the fixtures that are being dimmed. Do not size dimmers based on actual lamps installed in light fixtures, but on maximum lamp wattage ratings of light fixtures on that particular circuit.

3.5 SURFACE RACEWAYS:

A. Provide all receptacles and special purpose outlets required in surface raceways. See Section 16110 - Raceway Systems.

3.6 OCCUPANCY SENSORS:

A. Do not locate immediately adjacent to air diffusers. Coordinate exact placement with Division 15.

3.7 GROUNDING:

A. Provide electrical continuous, tight, grounding connections for wiring devices.

3.8 TESTING:

A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

3.9 IDENTIFICATION:

A. All devices shall be identified on the lower plate with panelboard name and circuit number.

B. Identification labels shall be as follows:

Normal Power	Black with White letters
Emergency Power	Red with White Letters

END OF SECTION 16140

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16155 - MOTOR STARTERS

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to motor starters.

1.2 DESCRIPTION OF WORK:

A. Extent of motor starter work is indicated by drawings and schedules.

B. Type of motor starters in this section include the following:

1. Fractional Horsepower Manual Starters
2. Non-Reversing Magnetic Starters
3. Two-Speed Non-Reversing Magnetic Starters
4. Combination Non-Reversing Magnetic Starters

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.

B. SUBMITTALS:

1. Shop Drawings: Submit manufacturer's data and dimensional details on motor starters including voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
2. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Manufacturers: Subject to compliance with all requirements, provide products of on of the following:

1. Allen Bradley
2. Cutler-Hammer
3. General Electric

4. Siemens
5. Square D

B. Maintenance, Stock, Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed units, but not less than 3 units of each, for both power and control circuit fuses.

2.2 THERMAL OVERLOAD UNITS:

A. Provide metal alloy, thermal overload units for all motor starters. Size to actual running full load current, not to motor plate current, after air and water balancing are completed.

2.3 FRACTIONAL HORSEPOWER MANUAL STARTERS:

A. Provide fractional horsepower manual starters for single-phase fractional horsepower motors up to and including 1 horsepower, equivalent to Square D Class 2510, Type F, of types, sizes, and electrical characteristics required to suit applications or as otherwise indicated on drawings. Provide NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage starter, with thermal overload units, red pilot light, and toggle operator with handle guard/lock-off. Provide ANSI/NEMA ICS 6, Type 1 enclosures, or where subject to weather or moisture, Type 3R.

2.4 NON-REVERSING MAGNETIC STARTERS:

A. Provide non-reversing magnetic starters equivalent to Square D Class 8536, Type S, of types, sizes, and electrical characteristics as required to suit applications or as otherwise indicated on drawings. Provide NEMA ICS 2, AC general-purpose Class A magnetic starter for induction motors. Provide encapsulated coil with operating voltage compatible with control system (coordinate with Division 15). Provide totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring. Provide straight-through wiring with all terminals clearly marked. Provide NEMA ICS, melting alloy, interchangeable, overload relays with one-piece thermal unit construction and under voltage protection in all phases. Provide replaceable overload relay control circuit contacts. Thermal units shall be required for starter to operate. Provide NEMA ICS 2, 2 each normally open and closed, field convertible, auxiliary contacts in addition to seal-in contact. Provide rotary-type, hand-off-auto and reset switches, recessed pushbutton control. Provide red pilot light. Provide control power transformer in each motor starter with fused primary and secondary. Provide each magnetic starter with integral phase failure protection that will protect against phase loss, phase unbalance, phase reversal, and undervoltage. Provide ANSI/NEMA ICS 6, Type 1 enclosures, or where subject to weather or moisture, Type 3R.

2.5 TWO-SPEED NON-REVERSING MAGNETIC STARTERS:

A. Provide two-speed, non-reversing magnetic starters equivalent to Square D 8810, of types, sizes, and electrical characteristics as required to suit applications or as otherwise indicated on drawings. Provide non-reversing magnetic starters with features as noted above in the description for "NON-REVERSING MAGNETIC STARTERS" with the following exceptions: Provide high/low pushbutton switches to select motor speed when operating in the hand mode. Provide green high speed and red low speed pilot lights. Label lights appropriately. Provide separate overload units for high and low speed windings. Provide consequent pole and/or separate winding starters as required to coordinate with motors

provided. Coordinate all work with Division 15.

2.6 COMBINATION NON-REVERSING MAGNETIC STARTERS:

A. Provide combination, non-reversing magnetic starters equivalent to Square D 8538, Type S (non-fusible and fusible disconnect switch type) and Square D 8539, Type S (motor circuit protector type), of types, sizes, and electrical characteristics as required to suit applications or as otherwise indicated on drawings. Provide non-reversing magnetic starters and/or two-speed non-reversing magnetic starters with features as noted above in the descriptions for "NON-REVERSING MAGNETIC STARTERS."

B. Where Combination Magnetic Starter/Motor Circuit Protector switches are specified, provide NEMA AB 1, circuit breakers with integral instantaneous magnetic trip in each pole. Provide circuit breakers with externally operable handles that give positive visual indication of ON-OFF positions with red and black color coding.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install motor starters in accordance with manufacturer's written instructions, applicable requirements of the NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices.

3.2 METHODS:

A. Install overload units so catalog number is visible. Mount chart inside each starter indicating heater type, size, and ampere ratings available.

B. Where sizes of starters, disconnect, fuses, motor circuit protectors, heaters, etc. are not indicated on drawings, size all equipment in accordance with manufacturer's written instructions.

C. Submit with the record drawings a record of the motor amperage readings of each electrically-driven unit; show horsepower, full-load amps and service factor.

3.3 IDENTIFICATION:

A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each starter cabinet. Provide red plastic laminate label for starter supplied by emergency power. Include mechanical equipment designation, horsepower, voltage, full-load amps, and service factor of motor. Mark on interior cover the source of power by indicating the panel and circuit number.

3.4 MOTOR CONNECTIONS:

A. Each motor shall be connected to the conduit with a length of flexible, seal-tight conduit (minimum of 18"), with proper type fittings. All motor supply circuits shall include a green ground conductor. Check for proper motor rotation on all motors or equipment.

END OF SECTION 16155

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16160 - PANELBOARDS

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to panelboards.

1.2 DESCRIPTION OF WORK:

A. Extent of panelboard work is indicated by drawings and schedules and is specified herein.

B. Type of panelboards in this section include the following:

1. Lighting and Appliance Panelboards
2. Power Distribution Panelboards

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.

B. SUBMITTALS:

1. Shop Drawings: Submit dimensioned drawings of panelboards and enclosures showing accurately scaled layouts of enclosures. Include schedule of devices, including, but not necessarily limited to, circuit breakers, fusible switches, fuses, ground-fault circuit interrupters, and accessories.
2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spacial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with all requirements, provide products from one of the follows:

1. Cutler-Hammer, Eaton Corp.
2. General Electric Co.
3. Siemens Energy & Automation, Inc.
4. Square D Co.

2.2 GENERAL:

A. Provide panelboards, enclosures, and ancillary components, of types, sizes, and ratings indicated. Provide overcurrent protective devices, etc. as indicated on drawings for a complete installation.

B. Where "Spaces" or "Blanks" are indicated on panelboard schedules, provide drilled bus and mounting hardware ready to receive breaker or fusible switch of size indicated on panelboard schedule.

2.3 PANELBOARD ENCLOSURES:

A. Provide Code gauge, galvanized or rust-resistant sheet steel enclosures in sizes and NEMA types to suit respective applications. The size of the wiring gutters and gauge of steel shall be in accordance with the latest NEMA Standards Publication and latest UL standards for panelboards. Flush locks shall not protrude beyond the front of the door. Key all enclosures alike and provide three keys at completion of the project. Fronts shall have adjustable indicating trim clamps, which shall be completely concealed when the doors are closed. Doors shall be mounted by completely concealed steel hinges. A circuit directory frame and card, with clear plastic covering shall be provided on the inside of the door. The directory cards shall be typewritten to identify each circuit service. Provide panel enclosures with doors hinged to enclosures. Provide ANSI-61 painted finish.

2.4 LIGHTING AND APPLIANCE PANELBOARDS:

A. Provide dead-front, safety-type lighting and appliance panelboards of types and electrical characteristic indicated. Provide copper bus bars, full-sized neutral bus, and ground bus. Provide insulated/isolated ground buses where indicated. Include overcurrent protective devices and switches in quantities, ratings, types, and arrangements shown. See Section 16180 - Overcurrent Protective Devices.

B. Rate devices, bussing, supports, etc. equal to or greater than the short circuit current rating indicated. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

2.5 POWER DISTRIBUTION PANELBOARDS:

A. Provide dead-front, safety-type lighting and appliance panelboards of types and electrical characteristic indicated. Provide wall-mounted or floor-standing power distribution panelboards as indicated. Provide panelboards suitable for use as service equipment where required. Provide copper bus bars, full-sized neutral bus, and ground bus. Provide insulated/isolated ground buses where indicated. Include overcurrent protective devices and switches in quantities, ratings, types, and arrangements shown. See Section 16180 - Overcurrent Protective Devices.

B. Rate devices, bussing, supports, etc. equal to or greater than the short circuit current rating indicated. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install panelboards in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 IDENTIFICATION:

A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on both the interior and exterior of each panelboard enclosure indicating name of panelboard. Bolt and nut or rivet labels to enclosure. (Sheet metal screws are not acceptable).

1. This label shall also indicate the feeder circuit. Mark on interior cover the source of power by indicating the panel and circuit number.

B. All subpanels shall be labeled to identify the main panel that supplies the feeder circuit.

C. Provide red plastic laminate label for panelboards supplied by emergency power.

3.3 MOUNTING:

A. Mount panelboards as indicated, but in no case higher than 6'-6" from finished floor to top of panel. Anchor enclosures firmly to walls and structural surfaces.

B. Provide 4" high concrete pad under floor-standing power distribution panelboards.

3.4 CIRCUIT DIRECTORIES:

A. For lighting and appliance panelboards, provide typed panelboard circuit directories. Indicate load description or name and location. Utilize actual building room numbers, not architectural room numbers used on drawings. Label the panel and circuit that feeds this panel.

B. For power distribution panelboards, provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.

1. Provide red plastic laminate label for emergency loads.
2. If circuits are changed in a panel, type the new circuit designation and glue on existing circuit directory. DO not discard existing panelboard schedule wnless all circuits have been changed.

3.5 WIRING METHODS:

A. Arrange conductors neatly within enclosure, and secure with suitable nylon ties.

B. Panelboards shall not be used for junction or splicing boxes or as a raceway.

3.6 ARRANGEMENT OF OVERCURRENT PROTECTIVE DEVICES:

A. The overcurrent protective devices shall be in the same sequence and labeled as the panel schedule on the drawings.

END OF SECTION 16160

Camp Williams Readiness Center
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SECTION 16170 - DISCONNECT SWITCHES

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to disconnect switches.

1.2 DESCRIPTION OF WORK:

A. Extent of disconnect switch work is indicated by drawings and schedules and is specified herein.

B. Type of disconnects in this section include the following:

1. Heavy Duty Disconnect Switches

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.

B. SUBMITTALS:

1. Product Data: Submit manufacturer's data on disconnect switches including specifications, installation instructions, etc.
2. Shop Drawings: Submit dimensioned drawings of disconnects showing accurately scaled layouts of disconnects and enclosures.
3. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spacial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with all requirements, provide general and heavy duty disconnect switches (fusible and non-fusible) and fusible switches (in power panels) from one of the following:

1. Cutler-Hammer
2. General Electric
3. Siemens
4. Square D

B. Subject to compliance with all requirements, provide bolted pressure switches from one of the following:

1. Bolt Switch
2. Cutler Hammer
3. General Electric
4. Pringle Switch
5. Siemens
6. Square D

2.2 GENERAL:

A. Provide fusible and/or non-fusible disconnect switches and ancillary components of types, sizes, ratings, and electrical characteristics as indicated. Provide enclosures in NEMA ratings suitable for applications. Provide fuses as indicated; See Section 16180 - Overcurrent Protective Devices.

2.3 HEAVY DUTY DISCONNECT SWITCHES:

A. Provide 600 volt rated, heavy duty switches in sheet steel enclosures as indicated of types, sizes, ratings, and electrical characteristics indicated and as required to suit respective application. Provide heavy duty switches for circuits rated greater than 240 volts, but less than 600 volts. Construct of spring-assisted, quick-make, quick-break mechanisms. Provide solid neutral as required by application. Equip with operating handle capable of being locked in the OFF position. Provide Class R rejection fuse clips for fusible-type switches.

2.4 FUSIBLE SWITCHES:

A. Provide factory-assembled, fusible switch units as integral components of distribution power panels and switchboards of types, sizes, ratings, and electrical characteristics indicated and as required to suit respective application. Provide quick-make quick-break mechanisms and visible blades. Equip with handle capable of being locked in the OFF position. Provide dual fuse door interlocks. Provide switch with Class R rejection fuse clips. Include copper lugs to accommodate conductors specified.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install disconnects in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 IDENTIFICATION:

A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each disconnect indicating name of disconnect or load served. Bolt labels to enclosure. Mark on interior cover the source of power by indicating the panel and circuit number.

B. Provide red plastic laminate label for disconnects supplied by emergency power

3.3 MOUNTING:

A. Mount disconnects as indicated, but in no case higher than 6'-6" from finished floor to top of disconnect. Anchor enclosures firmly to walls and structural surfaces.

END OF SECTION 16170

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16180 - OVERCURRENT PROTECTIVE DEVICES

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to overcurrent protective devices.

1.2 DESCRIPTION OF WORK:

A. Extent of overcurrent protective devices is indicated by drawings and schedules and is specified herein.

B. Type of overcurrent protective devices in this section include the following:

1. Molded Case Circuit Breakers
2. Fuses

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.

B. SUBMITTALS:

1. SHOP DRAWINGS: Submit manufacturer's data on overcurrent protective devices including specifications, time-current trip characteristics curves, mounting requirements, installation instructions, etc. Submit dimensioned drawings of overcurrent protective devices.
2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spacial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide overcurrent protective devices and ancillary components of types, sizes, ratings, and electrical characteristics indicated. Provide enclosures in NEMA ratings as indicated and suitable for applications.

2.2 MOLDED CASE CIRCUIT BREAKERS:

A. MANUFACTURERS:

Subject to compliance with all requirements, provide molded case circuit breakers from one of the following:

1. Cutler-Hammer
2. General Electric
3. Siemens
4. Square D

B. MOLDED CASE CIRCUIT BREAKERS:

1. Provide factory-assembled, molded case circuit breakers as integral components of lighting and appliance panelboards, power panelboards, switchboards, and for individual mounting as indicated. Provide thermal magnetic, molded case circuit breakers of amperages, voltages, types, and short circuit current ratings indicated. Provide bolt-on type breakers only. Construct with quick-break, quick-break mechanism with inverse-time delay and instantaneous trip protection for each pole. Provide breakers rated for ambient temperatures to suit respective applications. Provide mechanical screw type removable copper connector lugs of size to accommodate conductors specified.
2. Provide breakers that have interrupting ratings greater than or equal to the specified fault current. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

2.3 FUSES:

A. VENDORS:

Subject to compliance with all requirements, provide fuses from one of the following:

1. Bussmann
2. Gould Shawmut
3. Reliance
4. Littlefuse

B. FUSES:

General: Provide fuses as integral components of disconnects, fusible switches, and bolted pressure switches. Provide fuses in types and sizes as recommended by manufacturer's written instructions. Provide fuses for mains, feeders, and branch circuits as follows:

1. Circuits 601 to 6000 amperes: Shall be protected by current limiting Bussmann Low-Peak Time-Delay Fuses KRP-C or equivalent. Fuses shall be UL Class L with an interrupting rating of 200,000 amperes r.m.s. symmetrical.
2. Motor and Transformer Circuits 0 to 600 amperes: Shall be protected by current-limiting Bussmann Low-Peak Dual Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts) or equivalent. Fuses shall be UL Class RK1 with an interrupting rating of 200,000 amperes r.m.s. symmetrical.

3. Feeders to Circuit Breaker Panels 0 to 600 amperes: Shall be protected by current-limiting Bussmann Low-Peak Time Delay fuses LPJ or equivalent. Fuses shall be UL Class RK1 with an interrupting rating of 200,000 amperes r.m.s. symmetrical.

C. FUSE CABINETS:

1. Furnish and install fuse cabinet(s) equivalent to Bussmann SFC-FUSE-CAB.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install overcurrent protective devices in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 SIZING FUSES:

A. Size all fuses in accordance with manufacturer's written recommendations, whether fuse size is indicated on drawings or not. If nuisance tripping occurs, increase fuse size and disconnect if necessary as required to provide nuisance-free tripping. Adjust fuse size for proper ambient temperature, frequent starting and stopping of motor loads, and for loads with long start times.

3.3 IDENTIFICATION:

A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each disconnect indicating name of disconnect or load served. Bolt labels to enclosure. Mark on interior cover the source of power by indicating the panel and circuit number.

B. Provide red plastic laminate label for disconnects supplied by emergency power.

3.4 MOUNTING:

A. Mount disconnects as indicated, but in no case higher than 6'-6" from finished floor to top of disconnect. Anchor enclosures firmly to walls and structural surfaces.

B. Provide 4" high concrete pad under floor-standing disconnects.

3.5 SETTINGS:

A. Adjust settings of overcurrent protective devices as directed by engineer.

3.6 SPARE PARTS:

A. Spare Fuses: For each type and ampere rating, furnish one spare fuse for every 5 provided, but not less than three total.

B. Fuse Cabinets: Furnish and install fuse cabinet(s) in quantities as required, but in no case less than one, to house the spare fuses indicated above. Locate in main electrical room as directed by the Electrical Engineer.

END OF SECTION 16180

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SECTION 16289 - TRANSIENT VOLTAGE SUPPRESSION

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 TVSSs for low-voltage power.

B. Related Sections include the following:

1. Division 16 Section "Switchboards" for factory-installed TVSSs.
2. Division 16 Section "Panelboards" for factory-installed TVSSs.
3. Division 16 Section "Motor Control Centers" for factory-installed TVSSs.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.

B. Product Certificates: For transient voltage suppression devices, signed by product manufacturer certifying compliance with the following standards:

1. UL 1283.
2. UL 1449 2nd Edition.
3. UL 281-1 (fuse)
4. CSA 22.2.
5. NEMA LS-1

C. Manufacturer Seismic Qualification Certification: Submit certification that transient voltage suppression devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." 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. Products Testing: For transient voltage suppression devices, provide the following product test data:
1. Provide actual let through voltage test data in the form of oscillograph results for the ANSA/IEEE C62.41 Category C3 & C1 (combination wave) and B3 (ringwave) tested in accordance with ANSI/IEEE C62.45.
2. Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying the device noise attenuation equal or exceeds 50 db at 100 kHz.
3. Provide test report in compliance with NEMA LS1 from a recognized independent testing laboratory verifying that suppressor components can survive published surge current rating on both a per mode and per phase basis using the IEEE C62.41, 8 x 20 microsecond current wave. Note that test data on individual module is not accepted.

E. Field quality-control test reports, including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

F. Operation and Maintenance Data: For transient voltage suppression devices to include in emergency, operation, and maintenance manuals.

G. Warranties: Special warranties specified in this Section.

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 ANSI/IEEE C62.41.1-2002, "IEEE Guide for Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits,"; IEEE C62.41.2-2002, "IEEE Recommended Practice on Characterization of Surges in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45-2002, "IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."

C. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."

D. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449 2nd Edition, "Transient Voltage Surge Suppressors."

E. The manufacturer shall by ISO 9000 certified.

F. Comply with Military Standards MIL-STD220A.

G. Comply with FIPS Pub 94.

H. Comply with NEC 2002, Article 285, "Transient Voltage Surge Suppression TVSSs".

1.6 PROJECT CONDITIONS

A. 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.

B. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: -40 to 140 deg F (-40 to 60 deg C).
3. Humidity: 5 to 95 percent, noncondensing.
4. Altitude: Up to 20,000 feet (6090 m) above sea level.

1.7 COORDINATION

A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance. Coordinate placement of breakers in electrical panelboards feeding field-mounted surge suppressors so that conductor leads are kept to an absolute minimum.

B. Coordinate surge protection devices with Division 16 Section "Electrical Power Monitoring and Control."

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within five 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. Current Technology, Inc.
2. Cutler-Hammer, Inc.; Eaton Corporation.
3. General Electric Company.
4. LEA International.
5. Leviton Mfg. Company Inc.
6. Liebert Corporation; a division of Emerson.
7. Siemens Energy & Automation, Inc.
8. Square D; Schneider Electric.
9. United Power Corporation.

2.2 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 be greater than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor for the service entrance and other distribution level. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes - For a wye configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).
5. UL 1449 2nd Edition Suppressed Voltage Rating (SVR) - The maximum UL 1449 2nd Edition SVR for the device must not exceed the following:
   a. 208Y/120 V:
      1) L-N; L-G; N-G: 400 V.
      2) L-L: 800 V.
   b. 480Y/277 V:
      1) L-N; L-G; N-G: 800 V.
      2) L-L: 1800 V.
6. ANSI/IEEE Cat. C3 Let Through Voltage - The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20 kV, 10 kA) shall be less than:
   a. 208Y/120 V L-N: 560 V.
   b. 480Y/277 V L-N: 960 V.
7. ANSI/IEEE Cat. B3 Let Through Voltage - Let through voltage based on IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 ringwave (6 kV, 500 amps) shall be less than:
   a. 208Y/120 V L-N: 160 V.
   b. 480Y/277 V L-N: 165 V.

B. TVSS Design

1. 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 TVSS modules shall not be acceptable.
2. Electrical Noise Filter - Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHz shall be rejected.
3. Extended Range Filter - The Surge Protective Device shall have a High Frequency Extended Range Tracking Filter in each Line to Neutral mode with compliance to UL 1283 and NEMA LS1. The filter shall have published high frequency attenuation rating in the attenuation frequencies:
   a. Insertion Loss (ratio):
      1) 50kHz: 40
      2) 100kHz: 316

3) 500kHz: 316
4) 1MHz: 89
5) 10MHz: 200
6) 100MHz: 79

b. Insertion Loss (dB):
1) 50kHz: 32
2) 100kHz: 50
3) 500kHz: 50
4) 1MHz: 39
5) 10MHz: 46
6) 100MHz: 38

4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.
5. Standard Monitoring Diagnostics – Each TVSS shall provide integral monitoring options:
   a. Each unit shall provide a green / red solid state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light, shall indicate which phase(s) have been damaged.
   b. Contacts for Remote Status Monitoring – The TVSS device must include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.
6. Overcurrent Protection Fusing: In order to isolate the TVSS under any fault condition, the manufacturer shall provide:
   a. Individual Fusing: MOV's shall be individually fused via Copper Fuse Trace. The Copper Fuse shall allow protection during high surge (kA) events. TVSS shall safely reach an end-of-life condition when subjected to fault current levels between 0 and 200 kA, including low level fault currents from 5 to 5000 amperes.
   b. Thermal Protection: MOV's shall be equipped with Thermal Fuse Spring (TFS) technology which allows disconnection of the suppression component at the overheated stage common during temporary over voltage condition. For small fault currents between 100mA to 30Amp, or if the occurrence is over a longer period of time, the TFS will disconnect first. Manufacturers that utilize fuse trace only shall not be approved since there is no fault current protection between 100mA to 30A,
   c. All overcurrent protection components shall be tested in compliance with UL 1449-Limited Current Test and AIC rating test.

C. Minimum Repetitive Surge Current Capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 2002:

1. The suppression filter system shall be repetitive surge tested in every mode utilizing a 1.2 x 50 microseconds, 20kV open circuit voltage. 8 x 20 microsecond, 10kA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. The minimum repetitive surge current capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992 shall be:

   a. Service Entrance: 5000 impulse per mode.
   b. Distribution Locations: 5000 impulse per mode.
   c. Branch Locations: 5000 impulse per mode.

2.3 SYSTEM APPLICATION

A. Locations – Electrical drawings indicate the location and IEEE Category requirements of all required TVSS's.

B. Surge Current Capacity – The minimum total surge current 8 x 20 microsecond waveform that the device is capable of withstanding shall be as follows:

1. IEEE Category "C" Locations:
   a. Per Phase: 240kA.
   b. Per Mode: 120kA.
2. IEEE Category "B" Locations:
   a. Per Phase: 150kA.
   b. Per Mode: 80kA.
3. IEEE Category "A" Locations:
   a. Per Phase: 100kA.
   b. Per Mode: 60kA.

C. Lighting and Appliance Panelboard Requirements – Any one of the following options are acceptable:

1. Factory-Installed TVSS Option:
   a. The TVSS shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker options.
   b. The TVSS shall be immediately installed on the load side of the main breaker or main lugs.
   c. The panelboard shall be capable of re-energizing upon removal of the TVSS.
   d. A direct bus bar connection shall be used to mount the TVSS component to the panelboard bus bar to reduce the impedance of the shunt path.
   e. The TVSS panelboard shall be constructed using a direct bus bar connection (cable connection between bus bar and TVSS device in not acceptable). TVSS units that use a cable connection do not meet the intent of this specification. For this option, the breaker shown on the electrical drawings shall be deleted.
   f. The TVSS shall be included and mounted within the panelboard by the manufacturer of the panelboard.
   g. The TVSS shall be of the same manufacturer as the panelboard.
   h. The complete panelboard including the TVSS shall be UL67 listed.
2. Electronic grade Panelboard Extension Option:
   a. The TVSS shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker options.
   b. The TVSS shall be installed in an panelboard extension consisting of a box and trim as follows:
      1) Box: The unit's box shall be formed of galvanized and chemically cleansed metal and all breaks in galvanizing shall be painted with metallic paint. Minimum size shall be 16 " (406 mm) high and in width and depth to match the panelboard dimensions. It shall have removable tope and bottom end-plates to facilitate attachment to the top of bottom of a panelboard (also with removable end-plates) in order to provide a continuous barrier-free volume for routing feeder or branch wiring through the extension box. Collar hardware shall be provided to mate the panelboard and the box.
      2) Trim: The unit shall be constructed with gray baked enamel sheet

metal trim suitable for attachment to the panelboard. Trim shall be flush- or surface mounted to match panelboard trim requirements. Refer to panelboard schedules.

c. Provide a multi-pole circuit breaker in the panelboard in size as recommended by the manufacturer to feed the surge suppressor. The size of the breaker shall supercede the size of the breaker shown on the electrical drawings.

d. Provide copper conductors in size as recommended by the manufacturer for connecting the phases, neutral, and ground between the surge suppressor and the circuit breaker in the panelboard. The size of the conductor shall supercede the size of the conductors shown on the electrical drawings.

D. Power Distribution Panelboard Requirements – Any one of the following options are acceptable:

1. Factory-Installed TVSS Option:
   a. The TVSS shall be of the same manufacturer as the power distribution panelboard, motor control center, or switchboard.
   b. The TVSS shall be factory installed inside the power distribution panelboard, motor control center, or switchboard at the assembly point by the original equipment manufacturer.
   c. Locate suppressor on load side of main disconnect device or main lugs, as close as possible to the phase conductors and ground/neutral bar.
   d. Provide a disconnect sized in accordance with all manufacturer's recommendations. The disconnect shall be directly integrated to the suppressor and assembly bus by using bolted bus bar connections. The disconnect is the preferred method. If otherwise recommended by the manufacturer, provide a multi-pole circuit breaker in the panelboard in size as recommended by the manufacturer to feed the surge suppressor. The size of the breaker shall supercede the size of the breaker shown on the electrical drawings. Provide copper conductors in size as recommended by the manufacturer for connecting the phases, neutral, and ground between the surge suppressor and the circuit breaker in the panelboard. The size of the conductor shall supercede the size of the conductors shown on the electrical drawings.
   e. The TVSS shall be integral to power distribution panelboard, motor control center, or switchboard as factory standardized design.
   f. All monitoring diagnostics features shall be visible from the front of the equipment.

2.4 ENCLOSURES

A. Provide enclosures suitable for locations as indicated on the drawings or as described below:

1. NEMA 1/3R rainproof enclosures intended for outdoor use primarily to provide protection against rain, sleet and damage from external ice formation.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTION DEVICES

A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install devices for panelboard and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground at TVSS.

3.2 PLACING SYSTEM INTO SERVICE

A. Do not energize or connect electrical equipment to their sources until surge protection devices are installed and connected.

3.3 FIELD QUALITY CONTROL

A. Testing: Perform the following field tests and inspections and prepare test reports:

1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with requirements.
2. Complete startup checks according to manufacturer's written instructions.
3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

B. 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 transient voltage suppression devices. Refer to Division 1 Section "Closeout Procedures" or "Demonstration and Training" as may be applicable.

END OF SECTION 16289

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SECTION 16315 - OVERHEAD ELECTRICAL DISTRIBUTION

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 medium voltage, overhead electrical power distribution and demolition and upgrading of existing overhead electrical power distribution, and the following:

1. Conductors, connectors, and splices.
2. Hardware and accessories.
3. Surge arresters.
4. Cutouts, switches, and fuses.
5. Distribution transformers.

1.3 DEFINITIONS

A. ACSR: Aluminum conductor, steel reinforced.

B. BIL: Basic impulse level, stated in kilovolts.

C. HDPE: High-density polyethylene.

D. RUS: Department of Agriculture, Rural Utilities Service.

E. Secondary: Conductors and components for circuits operating at the utilization voltage of 600 V or less.

F. Service: Set of insulated conductors extending from a pole to the metering point or service entrance connection at the location of utilization of electricity.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Conductors.
2. Insulators.
3. Switches.
4. Cutouts.
5. Transformers.
6. Surge arresters.

B. Qualification Data: For testing agency.

C. Listing Documentation: Indicate products comply with RUS listing requirements specified in "Quality Assurance" Article.

D. Time-Current Coordination Curves: Illustrate optimum coordination of protective devices involved in the Work of this Section.

E. Field quality-control test reports.

F. Source Quality-Control Test Reports: Factory inspection reports of wood poles.

G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: 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 Part 3.

B. Electrical Components Normally Covered by Listing and Labeling Services: 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. Overhead-Line Components, Devices, and Accessories: Currently listed in RUS Informational Publication 202-1 without restriction for the intended application.

D. Comply with IEEE C2, except where stricter requirements are indicated or where local requirements that are stricter apply.

E. Strength of Line and Line Components Selected by Contractor: Provide grades of construction and strength required by IEEE C2 for conditions encountered at Project site for heavy line loading, unless otherwise indicated.

1.6 PROJECT CONDITIONS

A. 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.

1.7 COORDINATION

A. Coordinate with those responsible for communication systems that will have cables supported by poles installed according to this Section.

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. Fuses: One additional spare fuse or fuse element for each furnished fuse or fuse element.
2. Insulators: One for every 10 of each type, but no fewer than three of each type.

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.

2.2 CONDUCTORS, CONNECTORS, AND SPLICES

A. Manufacturers - Conductors:

1. AFC Cable Systems.
2. Alcan Cable Co.
3. BICC Cables Company.
4. Brugg Telecom Inc.
5. Florida Wire & Cable, Inc.
6. General Wire & Cable Co.
7. Hendrix Wire and Cable Inc.
8. Kerite Company (The); Innovation Systems Inc.
9. King Wire Inc.
10. Nokia Cables USA Inc.
11. Northern Lights Cable, Inc.
12. Okonite Company (The).
13. Rome Cable Corp.
14. Southwire Company.

B. Manufacturers - Connectors and Splices:

1. AB Chance Co.; Hubbell, Inc.
2. Connector Manufacturing Co.
3. Cooper Power Systems.
4. Hubbell, Inc.; Anderson Electrical Products, Inc.
5. Hubbell, Inc.; Fargo Manufacturing Company.

C. Medium-Voltage Line Conductors: Bare Aluminum Conductor, Steel Reinforced (ACSR), complying with ASTM B 232/B 232M or Hard-drawn copper (CU), complying with ASTM B 1 and ASTM B 8 to match existing.

D. Connectors, Splices, and Conductor Securing and Protecting Components: Items include wire clamps, ties, conductor armor, fittings, connectors, and terminals. Listed for the specific applications and conductor types and combinations of materials used. Descriptions as follows for various applications:

1. Copper to Copper: Copper alloy, complying with UL 486A.
2. Aluminum Composition to Aluminum Composition: Aluminum alloy, complying with UL 486B.
3. Copper to Aluminum Composition: Type suitable for this purpose, complying with UL 486B.
4. Taps for Medium-Voltage Line Conductors: Hot-line clamps, screw type, with concealed threads and bare, hard-drawn copper stirrups. Listed for the combination of materials being connected.
5. Splices under Tension: Compression type with strength exceeding the conductors spliced.
6. Splices and Terminations for Insulated Medium-Voltage Conductors: Comply with requirements in Division 16 Section "Medium-Voltage Cables."

2.3 HARDWARE AND ACCESSORIES

A. Description: Ferrous-metal items include, but are not limited to, bolts, nuts, washers, crossarm gains and braces, insulator pins, anchor rods, anchors, eyebolts, staples, and transformer brackets.

1. Comply with ANSI C135.1, ANSI C135.2, ANSI C135.4, ANSI C135.14, ANSI C135.22, ANSI C135.33, and RUS Informational Publication 202-1 listings.

B. Insulator Brackets: Hot-dip galvanized steel, style as indicated, designed to hold vertical-post- or -pin-type insulators, with two-bolt attachment to pole.

C. Insulators: Units rated 15 kV and above shall be free from radio interference.

1. Porcelain insulators shall be wet-process type, complying with the following types:
   a. Pin: ANSI C29.5.
   b. Line Post: ANSI C29.7. Include mounting stud of length suitable for each mounting arrangement used.
   c. Suspension: ANSI C29.2.
   d. Guy Strain: ANSI C29.4.
   e. Secondary Spool: ANSI C29.3, Class 53-2.

D. Grounding Materials: Comply with Division 16 Section "Grounding and Bonding," using materials listed by RUS for the intended purpose without restriction.

1. Conductors: No. 4 AWG, minimum; bare, solid, annealed copper, complying with ASTM B 8, unless otherwise indicated.
2. Ground Conductor Protectors: PVC or half-round wood molding.

2.4 SURGE ARRESTERS

A. Available Manufacturers:

1. Cooper Power Systems.
2. General Electric Company; Transmission Systems.
3. Joslyn Manufacturing Company.
4. Ohio Brass Company; Hubbell, Inc.
5. Tyco Electronics/Raychem.

B. Distribution-Class Surge Arresters: Porcelain, complying with IEEE C62.11 and NEMA LA 1.

2.5 CUTOUTS, SWITCHES, AND FUSES

A. Available Manufacturers:

1. ABB Inc.; Distribution Automation Equipment Division.
2. AB Chance Co.; Hubbell, Inc.
3. Cooper Power Systems.
4. S&C Electric Company.

B. Description: Medium-voltage disconnect, protective units shall be rated for the line-to-line voltage of the systems in which installed, unless higher ratings are indicated. BIL ratings 60 kV.

1. Momentary Current Rating of Switching Devices: 20 kA, asymmetrical at nominal system operating voltage. Confirm with Camp Williams prior to bid.
2. Fuse Characteristics: Time-current characteristics for each set of fuses selected according to written recommendations of manufacturer of component protected by the fuses and coordinated with upstream and downstream protective devices. Prepare time-current coordination curves according to IEEE 242 that illustrate optimum coordination of devices in this Project.
3. Interrupting Rating of Fuses: 20 kA minimum symmetrical A at nominal system operating voltage.

C. Fuse Cutouts: Open type, rated 100 A, continuous, complying with ANSI C37.42.

1. Fuses: Enclosed link, Type K, complying with ANSI C37.42.

2.6 DISTRIBUTION TRANSFORMERS

A. Manufacturers:

1. ABB Inc.; Distribution Automation Equipment Division.
2. Cooper Power Systems.
3. Fortune Electric Co., Ltd.
4. General Electric Company/GE Prolec; Distribution Transformer.
5. Howard Industries, Inc.
6. Interstate Transformer, LLC.
7. Kuhlman Electric Corporation.
8. Moloney Electric; Division of Hammond Manufacturing.
9. Pioneer Power Products, Inc.

10. Transformer Network, Inc.

B. Description: Single-phase, two-winding, two-bushing, liquid-filled, pole-mounting distribution type; suitable for external fuse and surge suppressor protection. Comply with RUS Specification D-10 and the following additional requirements:

C. Taps: Two, 2.5 percent above and below, high-voltage and full-load rated.

D. Mounting Brackets: Double, integral; suitable for pole mounting, either individually or in cluster, or on crossarm.

E. Minimum Efficiency: Class 1, as defined by NEMA TP 1, based on test results.

F. Bushings: Creepage distance shall exceed nominal value standard for unit rating by at least 75 percent.

2.7 SOURCE QUALITY CONTROL

A. Factory Tests: Conduct routine tests of transformers according to referenced standards.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install underground power and those indicated to be in raceway according to other applicable Division 16 sections.

B. Verify dimensions by field measurement, and identify locations of poles, guy anchors, and other features. Also identify locations of connection to new and existing supply lines and to primary and secondary services. Notify Architect of discrepancies and field conditions that are not indicated and that will affect installation.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."

3.2 CONDUCTOR INSTALLATION, GENERAL

A. Connections, Splices, and Terminations: Use kits listed for the specific type of connection and combination of materials used in the connection, or recommended for the specific use by manufacturer of material on which applied.

1. Splice Location: Do not install within 10 feet (3 m) of a support.
2. Line Conductors and Service Drops: Install so strength exceeds ultimate rated strength of conductor.
3. Splices and Terminations of Covered Conductors: Comply with manufacturer's written instructions.
4. Splices and Terminations of Insulated Conductors of Self-Supported, Medium-Voltage Cable: Comply with manufacturer's written instructions.

3.3 MEDIUM-VOLTAGE LINE CONDUCTOR INSTALLATION

A. Application: Install bare conductors, unless otherwise indicated.

B. Armor Rod: Install to protect conductors if line conductors are supported by insulators.

C. Flat Aluminum Armor Wire: Install to protect conductors if they are supported by, or attached to, galvanized or coated iron or steel clamps or fittings.

D. Support line conductors and taps as follows:

1. Use wire ties for conductor attachment to pin and vertical post insulators, unless otherwise indicated.
2. Install wire ties tight against conductor and insulator, and turn ends back, flat against conductor, to eliminate exposed wire ends.
3. Use wire clamps on horizontal post, dead end, and suspension insulators, unless otherwise indicated.

3.4 HARDWARE AND ACCESSORIES INSTALLATION

A. Install washers against wood and under nuts, including eyenuts and locknuts.

B. Install nuts and locknuts wrench-tight on threaded connections.

3.5 INSULATOR INSTALLATION

A. Medium-Voltage Line Application: Install pin or post type, except install suspension type at corners, angles, dead ends, and other locations where horizontal forces exceed rated values for pin or line-post-type units.

1. Install suspension insulators and hardware that have mechanical strength exceeding rated breaking strength of attached conductors.
2. Install horizontal line-post insulators for armless construction.

B. Post-Insulator Conductor Support: Where installed horizontally and for line angles more than 15 degrees, install clamp-top conductor clamps.

C. Install spool-type insulators for secondary lines mounted on clevis attachments or secondary racks.

3.6 SURGE ARRESTERS

A. Install surge arresters to protect distribution, and other items indicated.

3.7 CUTOUT, SWITCH, AND FUSE INSTALLATION

A. Hook-Stick-Operated Switches: Install to maximize safe operating access.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

B. Testing Agency: Perform the following tests and inspections and prepare test reports:

1. Furnish instruments and equipment required for tests that comply with NETA ATS.
2. Ground Resistance: Comply with Division 16 Section "Grounding and Bonding." Measure resistance of each separate grounding electrode, including pole grounds. Also measure resistance of separate grounding electrode systems before bonding together.
   a. Perform tests and obtain acceptable results before energizing any portion of overhead electrical distribution system.
   b. Results and Follow-up: If ground resistance for a single ground electrode or pole ground, tested individually, exceeds 25 ohms, add a ground electrode not less than 10 feet (3 m) away and interconnect with No. 2 AWG minimum bare conductor buried at least 12 inches (300 mm) below furnished grade.
3. Self-Supported, Medium-Voltage Cable: After installation and while cable is isolated, after terminations are installed and before connecting or energizing, apply dc voltage between each phase conductor and grounding connections of sheath or metallic shield. Comply with applicable NEMA WC 70 for method, voltage, duration, pass-fail performance, and other test criteria. Perform other field inspections and tests recommended by manufacturer.
4. New Surge Arresters, Cutouts, and Switches: Inspect after installation and connection to wiring. Verify that ratings and characteristics match approved submittals and comply with system requirements. Verify that installation complies with requirements and that clearances of units and connecting wiring comply with IEEE C2 requirements.
   a. Verify proper grounding of metallic equipment parts.
   b. Fuses and Disconnect Links: Verify that ratings and characteristics match submittals and comply with system requirements.
   c. Switches:
      1) Manually operate each cutout and switch at least three times, to verify proper operation.
      2) Verify correct contact alignment, blade penetration, travel stops, and arc interrupter operation.
   d. Verify that clearances of energized parts and connecting wires comply with IEEE C2 requirements.
5. Distribution Transformers: Inspect after installation and connection to wiring and verify that ratings and characteristics match approved submittals and comply with system requirements. Verify the integrity and good condition of unit.
   a. Inspect for physical damage, cracked insulators, leaks, tightness of connections, and overall mechanical and electrical integrity.
   b. Perform preenergizing inspections and tests recommended by manufacturer.
   c. Verify proper equipment grounding.
   d. Verify that clearances of terminals and connecting wires comply with IEEE C2.

C. Remove and replace malfunctioning units and retest as specified above.

3.9 ADJUSTING

A. Distribution Transformers: Set voltage taps as directed by Engineer.

3.10 CLEANING

A. After completing equipment installation, inspect equipment. Remove spots, dirt, and debris. Repair damaged finish to match original finish. For distribution transformer, use tank touchup paint provided by manufacturer.

1. Clean enclosures internally, on completion of installation, according to manufacturer's written instructions.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead electrical distribution.

END OF SECTION 16315

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16420 - SERVICE ENTRANCE

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to service entrances.

1.2 DESCRIPTION OF WORK:

A. Extent of service entrance work is indicated by drawings and schedules and is specified herein.

B. Work under this section includes the following:

1. Raceways and Conductors
2. Metering
3. Service Entrance Switchboards and/or Panelboards
4. Overcurrent Protective Devices and/or disconnects

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.

B. SUBMITTALS:

1. Shop Drawings: Submit manufacturer's data on service entrance equipment and accessories. Submit dimensioned drawings of service entrance equipment.
2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms containing service entrance equipment indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide service entrance equipment and accessories of types, sizes, ratings, and electrical characteristics indicated or as otherwise required to provide a complete system. See other applicable sections.

2.2 METERING:

A. Meters:

1. Subject to compliance with all requirements, provide metering equipment from one of the following:

General Electric
Siemens
Square D

B. Power Meters:

1. Provide Square D Power Logic Circuit Monitor, Class 3020, Model CM-2250, or equivalent, integrally mounted in service switchboard, completely wired with current transformers, potential transformers, control power transformer, and fusing.
2. Provide meter with the following features:
   a) Front panel features:
      i) Six-digit LED display
      ii) Kilo/Mega units LEDs
      iii) Meter indication LEDs
      iv) Setup/rest parameters
      v) Phase indication LEDs
      vi) Phase select button
      vii) Select meter buttons
      viii) Mode indication LEDs
      ix) Mode select button
      x) Optical communications port
   b) True RMS Metering
   c) Accepts standard CT and PT inputs
   d) 0.2% accuracy, current and voltage
   e) Min/Max displays for metered data
   f) On-board clock/calendar
   g) RS-485 Communications standard
   h) Setpoint controlled alarm/relay functions
   i) On-board event and data logging
   j) Waveform capture
   k) High-speed, triggered 12-cycle event capture
   l) Downloadable firmware
   m) Date/time for each Min/Max
   n) Optional voltage/power module, where required, for direct connection to 480Y/277 V systems.
3. Provide meter with instrumentation to displaying the following information:
   a) Real-time readings:
      i) Current (per phase, N, G, 3 phase)
      ii) Voltage (L-L, L-N).
      iii) Real power (per phase, 3 phase)
      iv) Reactive Power (per phase, 3 phase)
      v) Apparent power (per phase, 3 phase)
      vi) power factor (per phase, 3 phase)
      vii) Frequency
      viii) THD (current and voltage)

ix) K-factor (per phase)

b) Demand Readings:
- i) Demand current (per-phase present, peak)
- ii) Average power factor (3 phase total)
- iii) Demand real power (3 phase total)
- iv) Demand apparent power (3 phase total)

c) Energy Readings:
- i) Accumulated energy, real
- ii) Accumulated energy, reactive

d) Power Analysis Values:
- i) Crest factor (per phase)
- ii) K-factor demand (per phase)
- iii) Displacement power factor (per phase, 3 phase)
- iv) Fundamental voltages (per phase)
- v) Fundamental currents (per phase)
- vi) Fundamental real power (per phase)
- vii) Harmonic power
- viii) Unbalance (current and voltage)

4. Phase rotation

2.2 RACEWAYS AND CONDUCTORS:

A. Provide service entrance raceways and conductors in accordance with Section 16110 - Conduit Raceways, and Section 16120 - Conductors and Cables.

2.3 CT ENCLOSURES:

A. Provide CT enclosures complete with meter bases of types and sizes in accordance with all power company requirements. Provide steel reinforced, concrete pads with openings in accordance with same. Refer to "Concrete Bases" under Section 16001 - Electrical General Provisions. Verify and comply with all power company requirements prior to installation.

2.4 SERVICE ENTRANCE SWITCHBOARDS AND/OR PANELBOARDS:

A. Provide service entrance switchboards and/or panelboards in accordance with Section 16182 - Switchboards, and Section 16160 - Panelboards. Rate all service switchboards and/or panelboards as service entrance equipment.

2.5 OVERCURRENT PROTECTIVE DEVICES AND/OR DISCONNECTS:

A. Provide overcurrent protective devices and/or disconnects in service switchboards and/or panelboards in accordance with Section 16180 - Overcurrent Protective Devices, and Section 16170 - Disconnect Switches.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install service entrance equipment and accessories in accordance with manufacturer's

written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 TRANSFORMER LOCATIONS:

A. Verify and coordinate exact placement

3.3 COORDINATION:

A. Coordinate all service entrance work with other trades.

END OF SECTION 16420

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16452 - GROUNDING

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to grounding.

1.2 DESCRIPTION OF WORK:

A. Extent of grounding work is indicated by drawings and schedules and is specified herein.

B. Ground the complete electrical installation including the system neutral, metallic conduits and raceways, boxes, fittings, devices, cabinets, equipment, and separately derived systems in accordance with the NEC and all other applicable codes to provide a permanent, continuous, low impedance, grounding system.

C. Provide grounding system such that the resistance from the service entrance ground bus, through the grounding electrode to earth is not greater than 5 ohms.

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.

B. TESTING: Submit results of ground resistance testing as specified in this section. Include name of testing agency with report. Include test results in operation and maintenance manuals.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide grounding equipment and accessories of types, sizes, ratings, and electrical characteristics indicated or as otherwise required to provide a complete system.

2.2 GROUNDING CONDUCTORS:

A. Unless noted otherwise, provide grounding conductors with stranding and insulation types to match phase conductors. Provide conductors with green insulation if possible; otherwise wrap with green tape. Size ground conductors as indicated on drawings. Do not size ground conductors smaller than that allowable by NEC.

2.3 GROUND RODS:

A. Provide copper clad, steel, 3/4" diameter by 10' long, ground rods (Weaver, Cadweld, or equivalent).

2.4 TEST WELLS:

A. Provide precast concrete box 9-1/2" W. x 16" L. x 18" D. with light duty concrete cover for non-traffic areas or rated steel plate for traffic areas. Provide covers with lifting holes. Engrave cover with "Ground Rod".

2.5 CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND):

A. Provide a bare copper conductor encased along the bottom of concrete foundation or footing that is in direct contact with the earth and where there is no impervious water-proofing membrane between the footing and the soil. Size UFER ground conductor in accordance with the NEC. Extend conductor through a horizontal length of 30' minimum and encase with not less than 2 nor more than 5 inches of concrete separating it from surrounding soils.

2.6 INSULATED GROUNDING BUSHINGS:

A. Provide plated malleable iron body with 150 degree Centigrade molded plastic insulating throat, lay-in grounding lug with hardened stainless steel fastners (OZ Gedney BLG or equivalent).

2.7 CONNECTION TO PIPES:

A. Provide heavy duty, cast bronze, ground clamp systems with silicon bronze bolts and nuts (OZ Gedney G Series - B or equivalent).

2.8 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES:

A. Provide exothermic welds. (Cadweld or equivalent)

2.9 BONDING JUMPERS:

A. Provide bonding jumpers with hot dip galvanized malleable or ductile iron clamps, hot dip galvanized steel U-bolts, and tinned copper braids (OZ Gedney BJ Series or equivalent).

2.10 GROUND BUS:

A. Provide 1/4" x 4", copper ground bus complete with insulators and brackets in lengths and at mounting heights as indicated on drawings. Furnish complete with drilled holes and lugs to accommodate grounding conductors.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install grounding systems in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 CLEANING:

A. Thoroughly clean all metal contact surfaces prior to installation of clamp-on connectors.

3.3 SEPARATELY DERIVED SYSTEMS:

A. Ground each separately derived system in accordance with NEC Section 250-26 unless otherwise indicated on drawings.

3.4 SERVICE ENTRANCE GROUNDING:

A. Connect the following items using NEC sized copper grounding conductors (in NEC sized, conduits if concealment is required) to lugs on the service ground bus:

1. Conductor from the UFER ground.
2. Conductor from two ground rods driven exterior to building at not less than 10' apart.
3. Conductor from main incoming cold water piping system.
4. Conductor from building structural steel.
5. Conductor from separately derived systems.
6. Conductor from insulated ground bushings on service entrance conduits.
7. Additional ground rods as required to achieve resistance value specified.
8. Additional items indicated on drawings.

3.5 EQUIPMENT BONDING AND GROUNDING:

A. Provide an NEC sized conductor, whether indicated or not on the drawings, in raceways as follows:

1. Non-metallic conduits and ducts.
2. Distribution feeders.
3. Motor and equipment branch circuits.
4. Device and lighting branch circuits.
5. Full length of all multi-outlet assemblies and other surface wireways.

3.6 ADDITIONAL GROUNDING INSTALLATION REQUIREMENTS:

A. Provide grounding bushings on all service conduit and conduits installed in concentric/eccentric knock-outs or reducing washer at panelboards, cabinets, and gutters.

B. Provide bonding jumpers across expansion and deflection couplings in conduit runs, across pipe connections at water meters, and across dielectric couplings in metallic cold

water piping system. Connection to water piping system shall be made electrically continuous by connecting to the street side of the water main valve and/or installing additional bonding jumpers across the meter, valves or service unions that might be disconnected.

C. Provide bonding wire in all flexible conduits.

D. Isolated Ground Circuits: Circuits used for isolated ground outlets shall be run in separate raceways or shall have a separate green insulated ground conductor installed and tagged for identification at all outlet and junction boxes.

3.7 TEST WELLS:

A. All ground rods shall be driven external to building and shall be located in ground well boxes. Locate in landscaped areas where possible.

3.8 TESTING:

A. Obtain and record ground resistance measurements both from service entrance ground bus to the ground electrode and from the ground electrode to earth. Install additional bonding and grounding electrodes as required to comply with resistance limits specified under this Section. Use independent testing agency for all testing.

END OF SECTION 16452

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16510 - INTERIOR AND EXTERIOR BUILDING LIGHTING

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to interior and exterior building lighting.

1.2 DESCRIPTION OF WORK:

A. Extent of interior and exterior building lighting work is indicated by drawings and schedules and is specified herein.

B. Type of lighting fixtures in this section include the following:

1. Fluorescent
2. Incandescent / Halogen
3. High Intensity Discharge (HID)

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable. Provide fluorescent-lamp ballasts which comply with Certified Ballast Manufacturer's Association standards and carry the CBM label.

B. SHOP DRAWINGS: Submit manufacturer's data on interior and exterior building lighting fixtures. Submit dimensioned drawings of all lighting fixtures. Identify light fixtures by type and submit in alphabetical order.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide light fixtures of types as indicated on drawings or as approved by addenda. Provide light fixtures complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, starters, wiring, etc. Provide all light fixtures with safety latches where applicable.

B. Provide all detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chains, or safety cables.

C. Provide all exterior fixtures with damp or wet location labels as required by application.

D. Provide all light fixtures and support accessories as required for a complete system.

E. Consult architectural drawings for louvers (if any) to be provided by Division 16.

2.2 FLUORESCENT LIGHT FIXTURES:

A. FLUORESCENT BALLASTS:

1. Electronic:
   a. Manufacturers: Provide electronic ballasts from manufacturers specified as an integral part of light fixtures on the light fixture schedule. Where "generic" electronic ballasts are specified, provide products of one of the following for each fixture type:
      1) Advance Transformer
      2) Magnetek
      3) Motorola
      4) Osram Sylvania
   b. Electronic Ballasts: Whether specified specifically or generically, provide electronic, fluorescent lamp ballasts for each type of fluorescent fixture capable of operating lamps indicated. Provide high power factor (97% or greater), Class P, sound-rated A, and internally thermally protected ballasts. Provide ballasts with input third harmonic content not exceeding 10% for 120V ballasts and less than 15% for 277V ballasts, average lamp current crest factor of 1.7, frequency of operation 20 Khz or greater, and non-PCB capacitors. Unless specifically noted otherwise, provide all interior light fixtures, with full light output electronic ballasts. Equip all exterior light fixtures with low temperature starting ballasts. Comply with all manufacturer's written recommendations for all lamp-ballast combinations.
   c. Programmed Start Electronic Ballasts: Electronic ballasts shall be programmed start for maximum lamp life on shorter start cycles. Filament voltage shall be applied prior to the application of open circuit voltage to allow adequate heating of the filaments and then open circuit voltage is applied to start the lamps. Ballasts shall provide for a minimum lamp starting temperature of 0 Degrees F.
2. Dimming:
   a. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
      1) Lutron
      2) Dimming Ballasts:
   b. Dimming ballasts shall be provided as part of a fluorescent dimming system where ballasts and controls are made by the same manufacturer. Refer to Fluorescent Lamp Dimmers Section 140 - Wiring Devices.
   c. Ballasts shall be UL listed, Class P thermally protected and meet ANSI C62.41 (IEEE Publication 587, category A for surge protection.
   d. Dimming shall be smooth and continuous without flicker down to 1% light levels for T-12, and T-8 lamps (5% for T-5 lamps).
   e. Ballasts shall have a power factor greater than .95. ballast factor equal to .93, total harmonic distortion less than 10%, and lamp current crest factor less than or equal to 1.6.
   f. Ballasts shall be inaudible in a 27dB ambient throughout the dimming range.
   g. Ballasts shall be capable of striking lamps at any light level without first flashing to full light.
   h. Ballasts shall comply with FCC Part 18 regulations and shall not interfere with

other properly installed electrical equipment,

i. Ballasts shall have a minimum starting temperature of 10 Degrees C.

j. Ballasts shall be free of Polychlorinated Biphenyls (PCB's).

3. Ballast Fusing: All ballasts shall be externally and individually fused.

B. FLUORESCENT LAMPS:

1. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
   a. General Electric
   b. Phillips
   c. Osram Sylvania
2. Lamps: Provide fluorescent lamps in types, wattages, and sizes as indicated on fixture schedule. Unless specifically noted otherwise, equip interior light fixtures with full light output, energy-conserving, fluorescent lamps.
3. T-8 Lamps: Where T-8 lamps are specified, provide General Electric "Trimline", Sylvania "Octron", or Phillips only with initial lumens outputs of 2950 minimum.
4. Provide TCLP-compliant lamps where available from the manufacturer.

C. DIFFUSERS: Where acrylic diffusers are specified, provide 100 percent virgin acrylic compound with minimum thickness of .125 inches.

2.3 HIGH INTENSITY DISCHARGE (HID) LIGHT FIXTURES:

A. HID BALLASTS:

1. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
   a. Advance Transformer
   b. General Electric
   c. Universal
2. Ballasts: Provide electromagnetic, constant wattage, HID lamp ballasts for each type of HID fixture capable of operating lamps indicated. Provide high power factor (90% of greater) ballasts. Provide HID ballasts for each HID fixture with features in accordance with all manufacturer's written recommendations. Equip all exterior light fixtures with low temperature (-10 degree F.) starting ballasts. Comply with all manufacturer's written recommendations for all lamp-ballast combinations.

B. HID LAMPS:

1. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
   a. General Electric
   b. Phillips
   c. Osram Sylvania
   d. Venture
2. Lamps: Provide HID lamps in types, wattages, and sizes as indicated on fixture schedule.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install interior and exterior light fixtures in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 SUPPORT REQUIREMENTS:

A. RECESSED LIGHT FIXTURES:

1. Lay-in Ceilings: Support all light fixtures in lay-in ceilings independent from the ceiling system. Support each recessed light fixture from the building structure with #12 gauge steel wire attached to each corner. Provide clips to securely fasten lay-in light fixtures to Tee-Bars. Provide suspension bars for downlight fixtures in lay-in ceilings.
2. Gypsum Board, Plaster, or Similar Ceilings: Support all light fixtures in hard ceilings independent from the ceiling system. Support each recessed light fixture from the building structure with #12 gauge steel wire attached to each corner. Provide backing supports and all mounting accessories as required.
3. Fire Ratings: Provide gypsum board protection for each light fixture recessed in fire-rated ceiling as required to maintain fire rating of penetrated ceiling.

B. SURFACE MOUNTED LIGHT FIXTURES: Support all surface mounted fixtures from a 4" square octagonal outlet box connected to a standard 3/8" stud or box hangar where applicable. Include backing and supports as required to support weight of light fixture.

C. PENDANT AND STEM MOUNTED LIGHT FIXTURES: Provide pendants, rigid conduit stems, and flexible ball joint hangers for all pendant and stem hung fixtures.

3.3 PROTECTION AND CLEANING:

A. Protect installed and non-installed fixtures from damage during construction period.

B. Thoroughly clean all interior and exterior light fixtures. Do not mar or scar reflectors or diffusers. Repair all nicks and scratches to appearance of original finish. Remove protective plastic coverings on light fixtures at completion of project.

3.4 WIRING METHODS:

A. Route a minimum of 36" of 3/8" flexible conduit to each lay-in light fixture directly from an outlet box. Unless specified otherwise, flexible conduit shall not exceed 72" in length. Do not loop flexible conduit from fixture to fixture.

B. Grounding: Provide equipment grounding connections for each lighting fixture.

3.5 COORDINATION:

A. Refer to architectural reflected ceiling drawings for exact location and quantities of light fixtures, and ceiling types. Where conflicts occur between the architectural and electrical drawings, or where fixtures types do not coordinate with ceiling systems, notify

architect/engineer prior to bid. After bid and award of contract, provide all light fixtures as required to meet the intent of the construction documents. Coordinate fixture layouts and installations with ceiling installer prior to submitting shop drawings and during construction. Fluorescent light fixtures shall be not less than 1/2" from combustible materials.

3.6 SPARE PARTS:

A. LAMPS: Provide 15% spare lamps, but in no case less than one, of each type, wattage, and size used for the project.

B. ACRYLIC DIFFUSERS: Provide a spare acrylic diffusers and/or glass for each light fixture type and one for each additional unit for each ten fixtures. The quantity of any single type need not exceed 10.

C. ELECTRONIC BALLASTS: Provide 2% spare electronic ballasts.

3.7 WARRANTY:

A. LAMPS: Warranty incandescent and fluorescent lamps for a period of two months from substantial completion.

B. ELECTRONIC BALLASTS: Warranty electronic ballasts for parts and labor for complete replacement for a period of five years. Warranty shall include an allowance for nominal replacement labor and replacement of defective product.

END OF SECTION 16510

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16551 - EXTERIOR AREA LIGHTING

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.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to exterior area lighting.

1.2 DESCRIPTION OF WORK:

A. Extent of exterior area lighting work is indicated by drawings and schedules and is specified herein.

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 16001 - Electrical General Provisions and other sections as applicable.

B. SHOP DRAWINGS: Submit manufacturer's data on exterior area lighting items including but not necessarily limited to poles, brackets, light fixtures, fuse, fuseblocks, etc. Submit dimensioned drawings of all pole and lighting fixtures. Include information with interior and exterior building lighting fixtures.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide exterior lighting fixtures of types as indicated on drawings or as approved by addenda.

2.2 LIGHT FIXTURES:

A. Refer to Section 16510 - Interior and Exterior Building Lighting for requirements for exterior light fixtures, lamps, ballasts, etc.

2.3 POLES:

A. Provide poles and all accessories including but not necessarily limited to anchor bolts, templates for anchor bolt pattern, brackets, bolts, etc. Provide handhole and cover at base of each pole. Provide poles which have been primed and painted at the factory. Provide poles, anchor bolts, etc. in sizes as recommended by manufacturer to withstand windloadings.

2.4 CONCRETE BASES:

A. Provide 3000 psi class concrete, forms, steel reinforcement, tie wires, etc. as required. See drawings for details.

2.5 GROUND RODS:

A. See Section 16452 - Grounding for ground rod requirements.

2.6 FUSEHOLDER, FUSES, AND BREAK-A-WAY RECEPTACLES:

A. Provide fuseholders with break-a-way receptacles equivalent to Bussmann Tron Waterproof Fuseholders and Break-A-Way Receptacles in the base for all phase conductors and materials. Neutral fuse holder will use a shorting fuse insert. Provide Bussmann KTK-R fuses in ratings to suit respective applications and sized in accordance with all manufacturer's recommendations.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install exterior area lighting in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 INSTALLATION METHODS:

A. Set all poles plumb. Use belt slings or ropes to raise and set poles to protect finish. Repair nicks and scratches to match original surface.

B. Locate fuseholder at handhole. Provide fuse blanks in all neutral conductors.

C. Grounding: Provide one ground rod for each light pole. Connect ground rod to pole by means of an NEC-sized grounding conductor and all additional grounding as required.

3.3 CONCRETE BASES:

A. Provide concrete bases for light poles in accordance with details on drawings. Grout and hand-rub all concrete to a uniform smooth finish.

3.4 SPARE PARTS:

A. FUSES: Provide three spare fuses for each type and size used.

3.5 WIRING METHODS:

A. No common neutral multi-wire circuits will be used to feed area lighting. Provide dedicated neutral wire for each circuit indicated.

END OF SECTION 16551

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16610 - EMERGENCY ELECTRICAL 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 work of this section.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to emergency electrical systems.

1.2 DESCRIPTION OF WORK:

A. Types of emergency system components specified in this section include the following:

1. Emergency Diesel Generator Sets
2. Automatic Transfer Switches
3. Exhaust and Fuel Systems
4. Weather Protective Enclosure
5. Remote Annunciator Panel

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.

B. REQUIREMENTS OF REGULATORY AGENCIES:

1. The electric generating system consists of a prime mover, generator, governor, coupling and all controls which must have been tested as a complete unit on a representative engineering model as required by NFPA 110-1985. The tests, being potentially damaging to the equipment tested, must not be performed on the equipment to be sold, but on a separate prototype model.
2. Conform to N.E.C. and applicable inspection authorities.
3. Transfer switches to be labeled under UL 1008.

C. SHOP DRAWINGS: Submit dimensioned shop drawings of all emergency electrical system components and accessories including but not necessarily limited to emergency generator, protective enclosure, fuel tank, automatic transfer switch, battery charger, all instruments and accessories, and fuel piping requirements. Show accurately scaled layouts of system components. Submittals shall include complete system interconnection wiring diagrams and manufacturer's warranty form indicating compliance with these specifications.

D. OWNER'S MANUALS: Four (4) sets of owner's manuals specific to the product supplied must accompany delivery of the equipment. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

A. Engine Generator Sets: This engine generator sets and equipment from one of the following:

1. Caterpillar
2. Onan
3. Kohler

B. Automatic Transfer Switches: Provide automatic transfer switches and accessories from one of the following manufacturers:

1. ASCO
2. Onan
3. Russelectric
4. Zenith
5. Kohler

2.2 GENERAL:

A. Provide emergency electrical system components and specified herein and as shown on the drawings. Provide systems and components capable of start and load transfer within 10 seconds of power outages.

B. Please note that the generator is to deliver the specified KW rating as indicated on the drawings. Increase rating of generator as required for altitude and temperature ratings as follows:

1.	Altitude:	5500 Feet Above Sea Level
2.	Maximum Ambient Temperature:	50 Degrees C.
3.	Minimum Ambient Temperature:	0 Degrees C.

2.3 ENGINE-GENERATOR SET:

A. Engine: Provide 60 hertz alternating-current standby diesel engine driven generator units of voltage, phase, and capacities indicated. Base rating of electric sets upon operation after deducting power required for output for all necessary operating accessories including radiator fans, fuel pumps, etc. and under environmental conditions specified. Provide electric sets rated and capable of producing KW specified at 0.8 power factor. Certify performance of the electric set series by means of independent testing laboratory tests for full power rating stability, and voltage and frequency regulation. Provide stationary, water-cooled, full diesel, compression ignition, four stroke cycle, multi-cylinder or single cylinder, in-line or V-type engine. Arrange engine for direct connection to an alternator current generator; Do not exceed engine speed of 1800 RPM at full rated load.

B. Alternator: Provide direct connected, engine driven, single bearing, synchronous type alternator with electrical characteristics indicated.

1. Instantaneous Voltage Dip: Limit voltage dip of engine generator set to less than 30 percent upon application of full rated power. Accomplish voltage regulation by means of a solid state voltage regulator. Inherently regulated machines are acceptable in sizes under 6 KW.

    a. Stability: 1 percent of its mean value at any constant load from no load to full load for solid state regulators.
    b. Regulation: Plus or minus 2 percent maximum so load to full load for solid state regulators.

2. Where more than 40 percent of the load is comprised of rectifiers and/or thyristors, provide power to voltage regulator by means of ceramic type permanent magnet pilot excitor, capable or 80 percent automatic controlled SCR/Thyristor loading.

C. Lubrication System: Equip engine with a pressure lubricated system. Provide spin-on type full flow lubricating oil filter. Equip filters with bypass valve to insure oil circulation if filters are clogged. Include dipstick oil level indicator.

D. Air Cleaner: Provide reusable element air cleaner of size and type recommended by the engine manufacturer.

E. Starting: Equip engine with a 12 volt electric starting motor of sufficient capacity to crank the engine at a speed which will allow full diesel starting of the engine. Disengage starter automatically when engine starts.

F. Batteries: Provide rack-mounted, heavy duty, lead acid battery set of adequate voltage and amperage capacity to start and operate the engine. Provide sufficient capacity for cranking the engine for at least 30 seconds at firing speed with capacity for starting the diesel engine a minimum of four times. Provide capacity and voltage recommended by engine manufacturer. Provide all intercell and connecting battery cables as required.

G. Battery Charger: Provide an automatic dual rate battery charger manufactured by the engine-generator set supplier. The automatic equalizer system shall monitor and limit the charge current to 10 amps. The output voltage is to be determined by the charge current rate. The charger must have a maximum open circuit voltage of 35 volts and be protected against a reverse polarity connection. The battery charger is to be factory installed on the generator set. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.

H. Water Jacket Heater: Equip engine with thermostatically controlled water jacket heater. The heater voltage shall be 120 volt single phase for smaller units or 480 volt single-phase for larger units in KW rating as recommended by the manufacturer. Make all connections to water jacket heaters.

I. Engine Instruments: Provide a unit mounted console with the following gauges:

1. Run-stop-remote switch
2. Remote starting, 12-volt, 2 wire
3. Coolant temperature gauge
4. Field circuit breaker
5. DC voltmeter
6. Running time meter
7. Lamp test switch

8. Engine preheat switch
9. Oil pressure gauge
10. Fault reset switch
11. Cycle cranking
12. Time delay start/stop
13. 7-Light engine monitor with individual 1/2 amp relay signals and a common alarm contact for each of the following conditions:
    a. Run
    b. Pre-warning for low oil pressure
    c. Pre-warning for high coolant temp
    d. Low oil pressure shutdown
    e. High coolant temperature shutdown
    f. Overcrank shutdown
    g. Overspeed shutdown

J. Exhaust System: An exhaust silencer shall be provided of the size as recommended by the manufacturer and shall be of critical grade. Wrap the entire exhaust system, from manifold to roof or wall penetration with exhaust insulation The silencer(s) shall be mounted on the weather protective enclosure with the use of a flexible, seamless, stainless steel exhaust connection and rain cap. All components must be properly sized to assure operation without excessive back pressure when installed.

K. Engine Protection Devices: Provide the following engine protection devices with indicating light annunciation for each device:

1. Low-Oil pressure cut-out
2. High air temperature cut-out
3. Overspeed Cut-out

L. Mounting: Equip electric set with a suitable base for mounting on a level surface.

M. Isolators: Provide spring isolators between the electric set and base. Spring isolators between the engine and the base are acceptable if in accordance with manufacturer's recommendations.

N. Fuel: Provide engine capable of satisfactory performance on commercial grade diesel fuel as recommended by the manufacturer.

O. Governor: Equip engine with an electronic governor to maintain frequency within the limits as required to properly serve computer and electronic equipment.

P. Fuel System:

1. Equip engine with primary and secondary fuel filters with replaceable elements, and an engine driven fuel pump, all mounted on the engine. Provide fuel system piping of size and type recommended by the engine manufacturer.
2. The fuel system shall include a base-mounted fuel tank sized for 24 hours of run time at full load. It shall have the structural integrity to support the engine-generator set. Minimum features shall include all welded double-wall construction, a lockable fuel filler cap, fuel gauge, fuel line check valve and fittings for fuel supply, return, fill and vent. This tank must be supplied and warranted by the engine-generator set

manufacturer and be factory installed. The tank shall be provided with a complete leak detection system and control panel.

Q. Weather Protective Enclosure: The engine-generator set shall be factory enclosed in a heavy gauge steel enclosure constructed with corner posts, coated with electro statically applied zinc and finished with baked enamel paint. The enclosure is to have large, hinged doors to allow access to the engine, alternator and control panel. Each door is to be fitted with stainless steel, lockable hardware with identical keys. Padlocks do not meet this specification.

R. Main Line Circuit Breaker: Provide a main line circuit breaker in rating as indicated on the drawings, but in no case greater than that recommended by the generator manufacturer. Provide a breaker with AIC rating as required to safely interrupt and clear the maximum available fault current of the alternator to meet all NEC requirements.

2.4 AUTOMATIC TRANSFER SWITCHES

A. General: Automatic transfer switches shall be furnished by the manufacturer of the engine-generator set so as to maintain system compatibility and local service responsibility for the complete emergency power system. It shall be listed by Underwriter's Laboratory, Standard 1008 with circuit breaker protection. Representative production samples of the transfer switch supplied shall have demonstrated through tests the ability to withstand at least 10,000 mechanical operation cycles. One operation cycle is the electrically operated transfer from normal to emergency and back to normal. Wiring must comply with NEC table 373-6(b).

B. Ratings & Performance: Refer to electrical drawings for switch rating requirements.

C. Construction:

1. The transfer switch shall be double throw construction, positively electrically and mechanically interlocked to prevent simultaneous closing and mechanically held in both normal and emergency positions. Independent break before make action shall be used to positively prevent dangerous source to source connections. When switching the neutral, this action prevents the objectionable ground currents and nuisance ground fault tripping that can result from overlapping designs. The transfer switch shall be approved for manual operation. The electrical operating means shall be by electric solenoid. Every portion of the contactor is to be positively mechanically connected. No clutch or friction drive mechanism is allowed, and parts are to be kept to a minimum. This transfer switch shall not contain integral overcurrent devices in the main power circuit, including molded case circuit breakers or fuses.
2. The transfer switch electrical actuator shall have an independent disconnect means to disable the electrical operation during manual switching. Maximum electrical transfer time in either direction shall be 160 milliseconds, exclusive of time delays. Main switch contacts shall be high pressure silver alloy contacts to resist burning and pitting for long life operation.
3. There shall be one SPDT, 10 ampere, 250 volt auxiliary switch on both normal and emergency sides, operated by the transfer switch. Full rated neutral bar with lugs for normal, emergency and load conductors shall be provided inside the cabinet.

D. Controls:

1. All control equipment shall be mounted on the inside of the cabinet door in a metal lockable enclosure with transparent safety shield to protect all solid state circuit boards. This will allow for ease of service access when main cabinet lockable door is open, but to prevent access by unauthorized personnel. Control boards shall have installed cover plates to avoid shock hazard while making control adjustments. The solid state voltage sensors and time delay modules shall be plug-in circuit boards with silver or gold contacts for ease of service.
2. A solid state undervoltage sensor shall monitor all phases of the normal source and provide adjustable ranges for field adjustments for specific applications needs. Pick-up and drop-out settings shall be adjustable from a minimum of 70% to a maximum of 95% of nominal voltage. A utility sensing interface shall be used, stepping down line voltage to 24VAC, helping to protecting the printed circuit board from voltage spikes and increasing personnel safety when troubleshooting.
3. Signal the engine-generator set to start in the event of a power interruption. A set of contacts shall close to start the engine and open for engine shutdown. A solid state time delay start (adjustable, .1 to 10 seconds) shall delay this signal to avoid nuisance start-ups on momentary voltage dips or power outages.
4. Transfer the load to the engine-generator set after it reached proper voltage (adjustable, 70% to 90%) and frequency (adjustable, 80% to 90%). A solid state time delay (adjustable, 5 seconds to 3 minutes) shall delay this transfer to allow the engine- generator to warm-up before application of load. There shall be a switch to bypass this warm-up timer when immediate transfer is required.
5. Retransfer the load to the line after normal power restoration. A return to utility timer (adjustable, 1 to 30 minutes) shall delay this transfer to avoid short term normal power restoration.
6. The operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred. Controls shall provide an automatic retransfer of the load from emergency to normal if the emergency source fails with the normal source available.
7. Signal the engine-generator to stop after the load retransfers to normal. A solid state engine cool down timer (adjustable, 1 to 30 minutes) shall permit the engine to run unloaded to cool down before shutdown.
8. Provide an engine minimum run timer (adjustable, 5 to 30 minutes) to ensure an adequate engine run period.
9. Provide a solid state plant exercise clock to set the day and time of generator set exercise period. Actual time of day and exercise time shall be displayed. The clock shall have a one week cycle and be powered by the load side of the transfer switch. A battery must be supplied to maintain the circuit board energized when the load side of the transfer switch is de-energized. Include a switch to select if the load will transfer to the engine-generator set during the exercise period.
10. The transfer switch shall have a time delay neutral feature to provide a time delay (adjustable, .1 to 10 seconds) during the transfer in either direction, during which time the load is isolated from both power sources. This allows residual voltage components of motors or other inductive loads (such as transformers) to decay before completing the switching cycle. A switch will be provided to bypass this feature when immediate transfer is required.
11. Front mounted controls shall include a selector switch to provide for a NORMAL TEST mode with full use of time delays, FAST TEST mode which bypasses all time delays to allow for testing the entire system in less than one minute, or AUTOMATIC mode to set the system for normal operation.

12. Provide bright lamps to indicate the transfer switch position in either UTILITY (white) or EMERGENCY (red). A third lamp is needed to indicate STANDBY OPERATING (amber). These lights must be energized from utility or the engine-generator set.
13. Provide manual operating handle to allow for manual transfer. This handle must be mounted inside the lockable enclosure so accessible only by authorized personnel.
14. Provide a safety disconnect switch to prevent load transfer and automatic engine start while performing maintenance. This switch will also be used for manual transfer switch operation.
15. Provide LED status lights to give a visual readout of the operating sequence. This shall include utility on, engine warmup, engine warmup bypass, standby voltage "ready", standby frequency "ready", standby on, transfer to standby, return to utility, engine cool down, engine minimum run and fast test mode.

2.5 REMOTE ANNUNCIATOR PANEL:

A. General: Provide remote annunciator panel with the following features:

1. Provide visual indication of 20 separate alarm conditions. The panels shall monitor and be labeled as follows:
   a. GENSET RUNNING (Green)
   b. HIGH TEMP (Amber)
   c. LOW OIL PRESS (Amber)
   d. LOW TEMP (Amber)
   e. LOW FUEL (Amber)
   f. HIGH TEMP (Red)
   g. LOW OIL PRESS (Red)
   h. OVERCRANK (Red)
   i. OVERSPEED (Red)
   j. NOT IN AUTO (Red-flashing)
   k. BLANK (Red)
   l. BLANK (Red)
2. Switchable lenses and alarm horn function.
3. Removable legend plates for engraving alarm or status labels.
4. Alarm silence button on annunciator resets circuit for any subsequent fault condition whether or not initial fault has been cleared.
5. Designed for operation at 24 VDC, with negative ground signals.
6. Stainless steel front panel for flush or surface mounting. Refer to drawings for mounting requirements.
7. Knockouts for conduit connections.
8. Replaceable 25,000 hour high intensity lamps for easy readability, high reliability, and low power consumption.
9. Lamp Test/Alarm silence switch.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install emergency electrical systems in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 MOUNTING:

A. Generator Sets:

1. Housekeeping Pads: Unless noted otherwise, provide 6" high steel reinforced concrete pad for generator sets. Adjust height of pad and steel reinforce in accordance with all manufacturer's recommendations - verify prior to installation. Refer to "Concrete Bases" under Section 16001 - Electrical General Provisions.

B. Transfer Switches:

1. Anchor switches firmly to walls and structural surfaces.
2. Housekeeping Pads: Provide housekeeping pads in accordance with "Concrete Bases" under Section 16001 - Electrical General Provisions.

3.3 FACTORY TESTING:

A. Before shipment of the equipment, the engine-generator set shall be tested under rated load and power factor for performance and proper functioning of control and interfacing circuits. Tests shall include:

1. Verifying all safety shutdowns are functioning properly.
2. Single step load pick-up per NFPA 110-1985, Paragraph 5-13.2.6.
3. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.

3.4 SERVICE:

A. Supplier of the electric set and associated items shall have permanent service facilities in this trade area. These facilities shall comprise a permanent force of factory trained service personnel on 24 hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the owner maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Service contracts shall also be available.

3.5 WARRANTY:

A. The standby electric generating system components, complete engine-generator, instrumentation panel, and automatic transfer switch shall be warranted by the manufacturer against defective materials and factory workmanship for a period of one year. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for travel and labor. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. Also, in the judgement of the specifying authority, the manufacturer supplying the warranty for the complete system must have the financial strength and technical expertise with all components supplied to provide adequate warranty support.

3.6 CHECKOUT & STARTUP:

A. The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to checkout the completed installation and to perform an initial startup inspection to include:

1. Ensuring the engine starts (both hot and cold) within the specified time.
2. Verification of engine parameters within specification.
3. Set no load frequency and voltage.
4. Test all automatic shutdowns of the engine-generator.

3.7 LOAD BANK TEST:

A. Conduct a load bank test to the rated KW of the generator for a minimum of four hours.

3.8 MISCELLANEOUS:

A. Provide engine lubricating oil, fuel, engine coolant, filters, etc. for system testing. After testing, refill all fluids to capacity for final acceptance.

B. Provide line voltage wiring for battery chargers, heaters, and leak detection system.

C. Provide low voltage control and monitoring wiring for all transfer switches and remote annunciators as may be specified.

END OF SECTION 16610

SECTION 16715 - VOICE AND DATA COMMUNICATION CABLING

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 items for wiring systems used as signal pathways for voice and high-speed data transmission:

1. Mounting elements.
2. Unshielded twisted-pair cabling.
3. Fiber-optic cabling.
4. Coaxial cable.
5. Multi-user telecommunications outlet assemblies.
6. Workstation outlets.
7. Backboards.
8. Identification products.

B. Related Sections include the following:

1. Division 13 Section "Security Access" for data transmission meeting RS-232 and RS-485 cabling associated with system panels and devices.

1.3 DEFINITIONS

A. Backbone: A facility (e.g., pathway, cable, or conductors) between telecommunications rooms or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.

B. BICSI: Building Industry Consulting Service International.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. Horizontal Cabling: Cabling between and including the telecommunications outlet/connector and the horizontal cross-connect. Also the cabling between and including the building automation system outlet or the first mechanical terminations on the horizontal connection point and the horizontal cross-connect.

F. IDC: Insulation displacement connector.

G. LAN: Local area network.

H. RCDD: Registered Communications Distribution Designer.

I. RMC: Rigid metallic conduit.

J. UTP: Unshielded twisted pair.

K. UTNG: Utah National Guard.

1.4 SUBMITTALS

A. Shop Drawings:

1. Include dimensioned plan and elevation views of telecommunications equipment rooms, labeling each individual component. Show equipment rack assemblies, method of field assembly, workspace requirements, and access for cable connections.
2. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
3. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
4. Cabling Administration Drawings.
5. Wiring diagrams to show typical wiring schematics including the following:

a. Workstation outlets, jacks, and jack assemblies.
b. Patch cords.
c. Patch panels.
d. Fiber-optic boxes.
e. Distribution racks.
f. Terminal racks.

B. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration.

C. Manufacturer Seismic Qualification Certification: Submit certification that distribution racks, patch panels, and their components will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:

1. Basis for Certification: Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based. 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."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity of each rack-mounted component and of each assembled rack type, 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 and Experience: For key personnel and installer.

E. Source quality-control test reports.

F. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling installer must have on staff personnel certified by BICSI.

1. Layout Responsibility: Preparation of Shop Drawings Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of a Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

B. Source Limitations: Obtain all products except cables through one source from manufacturers provided in UTNG Statement of Work, Performing Telecommunications Projects.

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 NFPA 70, "National Electrical Code."

1.6 COORDINATION

A. All projects are to be coordinated and approved through the UTNG State Telecommunications Manager, Mike Hansen. Coordinate layout and installation of voice and data communication cabling with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute to other participants.
3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

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. Outlet Assemblies: One for each type for every 25 outlets shown on plans, but no fewer than one.
2. Patch-Panel Units: One of each type.
3. Connecting Blocks: One of each type.
4. Device Plates: One of each type.
5. Multi-user Telecommunications Outlet Assemblies: One of each type.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SYSTEM REQUIREMENTS

A. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

B. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in cross-connect and patch panels, and terminal strips to accommodate 50 percent future increase in the number of workstations shown on Drawings. This expansion requirement does not apply to horizontal cable from workstation outlet to first terminal board.

2.3 MOUNTING ELEMENTS

A. Backboards: 3/4-inch (19-mm), interior-grade, fire-retardant-treated plywood.

B. Distribution Racks: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.

1. Module Dimension: Width compatible with EIA 310 standard 19-inch (480-mm) panel mounting.
2. Finish: Baked-polyester powder coat.

C. Power Strips: For mounting in the rack, with 20-V ac, NEMA WD 6, Configuration 15-15R receptacles, number as indicated, but in no case fewer than 6, and including the following:

1. LED indicator lights for power and protection status.
2. LED indicator lights for reverse polarity and open outlet ground.
3. Circuit breaker and thermal fusing. When protection is lost, circuit opens and cannot be reset.
4. Circuit breaker and thermal fusing. Unit continues to supply power if protection is lost.
5. Close-coupled, direct plug-in.
6. Rocker-type on-off switch, illuminated when in on position.
7. Peak Single-Impulse Surge Current Rating: 13 kA per phase.
8. Protection modes shall be line-to-neutral, line-to-ground, and neutral-to-ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.
9. One RJ11/12C telephone line protector, suitable for modem connection. Maximum clamping voltage 220 peak on pins No. 3 and No. 4.

D. Floor-Mounting Rack: Steel, freestanding, modular, with vertical and horizontal cable management channels, top and bottom cable troughs, and grounding lug.

E. Cabinets: Steel, freestanding, modular, with removable and lockable side panels, front and rear doors, ventilation openings in rear door and top panel, and the following components:

1. Provisions for a roof-mounted ventilation fan.
2. 250-cfm (118-L/s) roof-mounted ventilation fan.
3. Key all locks alike.

2.4 UNSHIELDED TWISTED-PAIR CABLING

A. Cable Manufacturers:

1. CommScope Properties, LLC. In Accordance with UTNG facilities standards.

B. Terminal and Connector Component and Distribution Rack Manufacturers:

1. Seimon. Part numbers in accordance with UTNG facilities standards.

C. 100-Ohm UTP: Comply with UL 444.

D. Backbone Copper Cable:

1. No. 24 AWG, 5o pair.
2. Comply with ICEA S-80-576 and TIA/EIA-568-B.2, Category 3.
3. NFPA 70, type CMR complying with UL 1666.
4. Cable Jacket Color: Gray.

E. Horizontal Copper Cable:

1. No. 24 AWG, 100 ohm, four pair.
2. Comply with TIA/EIA-568-B.2, Category 5e/6.
3. NFPA 70, types CMG and CMP.
4. Cable Jacket Colors: Blue and Yellow.

F. Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, using modules designed for punch-down caps or tools.

1. IDC Terminal Block Modules: Integral with connector bodies, including plugs and jacks where indicated.
2. IDC Connecting Hardware: Consistent throughout Project.

G. Cross-Connect Panel: Modular array of IDC terminal blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables plus 25 percent spare.

H. Patch Panel: Comply with TIA/EIA-568-B.2, meeting or exceeding cable performance. Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated.

I. Jacks and Jack Assemblies: Modular, color-coded, RJ-45 receptacle units with integral IDC-type terminals. Use keyed jacks for data service.

J. Patch Cords: Factory-made, four-pair cables in 48-inch (1200-mm) lengths; terminated with RJ-45 plug at each end. Use keyed plugs for data service.

2.5 FIBER-OPTIC CABLING

A. Cable, Terminal, and Connector Product Manufacturers:

1. Avaya Inc.
2. Berk-Tek; an Alcatel Company.
3. Chromatic Technologies; a Draka USA Company.
4. CommScope Properties, LLC.
5. Corning Cable Systems.
6. General Cable Technologies Corporation.
7. Mohawk/CDT; a division of Cable Design Technologies.
8. Molex Premise Networks; a division of Molex, Incorporated.
9. Nordex/CDT; a Subsidiary of Cable Design Technologies.
10. Optical Cable Corporation.
11. Panduit Corp.
12. Prestolite Wire Corp.
13. Superior Essex; Superior Telecommunications Inc.

B. Fiber-Optic Cable: 62.5/125-micrometer, multimode optical fiber.

C. Backbone Fiber Cable: 12 fibers.

1. Comply with TIA/EIA-492AAAA, tight buffer.
2. NFPA 70, Type OFN complying with UL 1666.
3. Maximum Attenuation: 3.5dB/km at 850 nm.
4. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
5. Cable Jacket Color: Orange.

D. Cross-Connect and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to satisfy specified expansion criteria.

E. Patch Cords: Factory-made, dual fiber cables in 36-inch (915-mm) lengths.

F. Cable Connecting Hardware:

1. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex- and duplex-Type SC or ST (site dependant) couplers. Insertion loss not more than 0.7 dB.
3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.6 COAXIAL CABLE

A. Manufacturers:

1. Alpha Wire Company.
2. B & L Coaxial Connections Ltd.
3. Belden Inc.; Electronics Division.
4. Coleman Cable.
5. CommScope Properties, LLC.
6. Helix/HiTemp Cables, Inc.
7. JSC Wire & Cable.
8. West Penn Wire/CDT; a division of Cable Design Technologies.

B. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz, and shall be listed to comply with NFPA 70, Articles 810 and 820.

C. RG-6/U: No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid. Jacketed with black PVC or PE. Suitable for indoor installations; NFPA 70, Type CATV or CM.

D. Coaxial-Cable Connectors: Type BNC, 75 ohms. Of three-piece construction, consisting of a crimp-type center tit, sleeve, and main body.

2.7 WORKSTATION OUTLETS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, modular, RJ-45. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Dual jack-connector assemblies mounted in single or multigang faceplate.

1. Faceplate: High-impact plastic; color as selected by Architect.
2. Mounting: Flush, unless otherwise indicated.
3. Legend: Factory-labeled, top jack "Voice" and bottom jack "Data," by silk-screening or engraving.
4. Legend: Machine-printed, adhesive tape label identifying the circuit.

C. Flush dual fiber-optic connector assemblies mounted in 2-gang faceplate with flush dual RJ-45 jack assembly.

1. Faceplate: High-impact plastic; color as selected by Architect.
2. Mounting: Flush, unless otherwise indicated.
3. Legend: Factory-labeled, fiber-optic connectors "Data" and RJ-45 jacks "Voice," by engraving.
4. Legend: Machine-printed, adhesive tape label identifying the circuit.

2.8 BACKBOARDS

A. A-C, void-free plywood, 84 inches (2130 mm) high and 3/4-inch (19 mm) thick, fire rated.

B. Positioning and coloring in accordance with UTNG Statement of Work Performing Telecommunications Projects.

2.9 GROUNDING AND BONDING

A. Materials: Comply with NFPA 70, TIA/EIA-607, and UL 467.

2.10 IDENTIFICATION PRODUCTS

A. Manufacturers:

1. Brady Worldwide, Inc.
2. HellermannTyton.
3. Kroy LLC.
4. Panduit Corp.
5. <Insert manufacturer's name.>

B. Comply with TIA/EIA-606-A and with applicable requirements in Division 16 Section "Electrical Identification."

C. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

D. Computer-based cable management system, with integrated database capabilities.

1. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.
2. Information shall be presented in database view, schematic plans, or technical drawings.
   a. AutoCAD drawing software shall be used as drawing and schematic plans software.
3. System shall interface with the following testing and recording devices:
   a. Direct upload tests from circuit testing instrument into the PC.
   b. Direct download circuit labeling into labeling printer.

2.11 SOURCE QUALITY CONTROL

A. Coaxial Cable: Each cable spool sweep tested at the factory before shipping at frequencies from 5 MHz to 1 GHz. Sweep test shall test frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through specified frequency range and graphing the results.

B. Fiber-Optic Cable: Each cable spool tested at factory before shipping at 850 and 1300 nm.

C. UTP Cable Verification of Performance: Test every cable package or reel at factory to verify that cable complies with TIA/EIA-568-B.2 requirements.

PART 3 - EXECUTION

3.1 INSTALLATION STANDARDS

A. Comply with BICSI TCI, TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, and TIA/EIA-569-A.

B. Comply with UTNG facilities standards. All work is to be

3.2 EXAMINATION

A. Examine pathway elements intended for cables.

1. Verify proposed routes of pathways. Check raceways, cable trays, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements.
2. Prepare wall penetrations and verify that penetrations of rated fire walls are made using products labeled for type of wall penetrated.
3. Identify plan to support cables and raceways in suspended ceilings. Verify weight of individual types and sizes of cables. Verify that load capacity of cable support structures is adequate for each pathway.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 APPLICATION OF MEDIA

A. Backbone Cable for Data Service: Use fiber-optic cable for runs between equipment rooms and wiring closets and for runs between wiring closets.

B. Backbone Cable for Voice Service: Use UTP Category 3e cable for runs between equipment rooms and wiring closets and for runs between wiring closets.

C. Horizontal Cable for Data Service: Use UTP Category 5e/6 (site specific) cable for runs between wiring closets and workstation outlets.

D. Horizontal Cable for Voice Service: Use UTP Category 5e/6 (site specific) cable for runs between wiring closets and workstation outlets.

3.4 INSTALLATION

A. Comply with NECA 1 and TIA/518B.

B. Wiring Method: Install cables in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces. Cable trays are specified in Division 16 Section "Cable Trays." Raceways and boxes are specified in Division 16 Section "Raceways and Boxes."

C. Cable Installation:

1. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
2. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.
3. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
4. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

5. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install UTP cables using techniques, practices, and methods that are consistent with Category 5e/6 rating of components and that ensure Category 5e/6 performance of completed and linked signal paths, end to end.
   a. Do not untwist more than 1/2 inch (12 mm) of Categories 5e and 6 cables at connector terminations.
7. Outdoor Coaxial Cable:
   a. Outdoor connections shall be installed in enclosures complying with NEMA 250, Type 4X. Connectors shall be corrosion resistant with properly designed O-rings to keep out moisture.
   b. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

D. Wiring within Wiring Closets and Enclosures:

1. Install plywood backboards on walls of equipment rooms and wiring closets from floor to ceiling.
2. Mount patch panels, terminal strips, and other connecting hardware on floor-mounted racks.
3. Group connecting hardware for cables into separate logical fields.
4. Train conductors to terminal points with no excess.
5. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

E. Separation from EMI Sources: Comply with BICSI TDM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment. Comply with the following minimum separation distances from possible sources of EMI:

1. Separation between unshielded power lines or electrical equipment in proximity to open cables or cables in nonmetallic raceways is as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: 24 inches (610 mm).
2. Separation between unshielded power lines or electrical equipment in proximity to cables in grounded metallic raceways is as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: 12 inches (300 mm).
3. Separation between power lines and electrical equipment located in grounded metallic conduits or enclosures in proximity to cables in grounded metallic raceways is as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: 6 inches (150 mm).
4. Electrical Motors and Transformers, 5 kVA or HP and Larger: 48 inches (1200 mm).
5. Fluorescent Fixtures: 5 inches (127 mm).

F. Conduit:

1. Comply with TIA/EIA-569-A for maximum length of conduit and bends between pull points, and for pull-box sizing.

2. Use manufactured conduit sweeps and long-radius ells whenever possible.
3. In telecommunications rooms, position conduit ends adjacent to a corner on backboard (in case of a single piece of plywood) or in the corner of room (where multiple sheets of plywood are installed around perimeter walls of room). Use cable trays to route cables if conduits cannot be located in these positions. Secure conduits to backboard when entering room from overhead. Extend conduits 1 to 3 inches (25 to 76 mm) in finished floor.

G. Backboards: Install plywood with 84-inch (2130-mm) dimension from floor up toward ceiling. Butt adjacent sheets tightly, and form smooth gap-free corners.

3.5 GROUNDING

A. Comply with Division 16 Section "Grounding and Bonding" and with TIA/EIA 607.

B. Grounding Points:

1. Locate grounding terminals in each equipment room, wiring closet, rack, and cabinet.
2. Telecommunications Grounding Busbars: Mount on wall of telecommunications entrance facility, equipment room, and closet, with standoff insulators.

C. Bonding Conductors:

1. Extend from telecommunications entrance facility to electrical entrance facility and connect to grounding electrode.
2. Where a panelboard for telecommunications is located in same room or space as a grounding busbar, bond to equipment ground bus of electrical panelboard.
3. Extend from telecommunications entrance facility to grounding busbars.
4. Extend from grounding busbars to ground terminals in equipment racks and cabinets.
5. Extend from grounding busbars to building metal frame within room, or to metal frame external to room but readily accessible.

D. Special Requirements:

1. Bonding conductors shall be insulated copper, No. 6 AWG minimum.
2. Install only in nonmetallic conduit, unless specifically required for protection of conductor. Metallic conduit, if used, shall be RMC. For RMC that exceeds 36 inches (915 mm) in length, conductors shall be bonded at each end of conduit.
3. Bonding conductors shall be installed without splices unless approved by Architect because of special circumstances. Where splices are necessary, they shall be accessible and shall be located in telecommunications spaces. Splices shall be by irreversible compression connectors or by exothermic welding.

3.6 IDENTIFICATION

A. In addition to requirements in this Article, comply with TIA/EIA-606-A and with applicable requirements in Division 16 Section "Electrical Identification."

1. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Using cable and asset management software specified in Part 2, develop Cabling

Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable, jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement. At completion, cable and asset management software shall reflect as-built conditions.

C. Use logical and systematic designations for facility's architectural arrangement and nomenclature, and a consistent color-coded identification of individual conductors.

D. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
   a. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
   b. Label each unit and field within distribution racks and frames.
5. Within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
6. At Workstations: Label cables within outlet boxes.

E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cable administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Results of testing shall be turned in to UTNG Telecommunications Manager.

B. Perform the following field tests and inspections and prepare test reports:

1. Category 5e/6 UTP Cabling Tests:
   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in Annex I, complying with measurement accuracy specified in Annex H. Use

only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

c. Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.

d. Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal-level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with minimum criteria in TIA/EIA-568-B.2.

2. Fiber-Optic Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Link End-to-End Attenuation Tests:

a. Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

b. Attenuation test results for horizontal links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

c. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

d. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

e. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.

3.8 DEMONSTRATION

A. Train appropriate UTNG personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 16715

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16721 - ALARM & DETECTION 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 work of this section.

B. This section is a Division-16 Basic Materials and Methods section, and is part of each Division-16 section making reference to fire alarm and detection systems.

1.2 SUMMARY: .

A. SCOPE: Includes but is not necessarily limited to the following:

1. Provide alarm and detection system as described in Contract Documents.
2. Provide raceway, conductors, boxes, and miscellaneous items required for complete system.

B. RELATED SECTIONS:

1. Division 15000 - Water flow switches, post indicating valves, and valve tamper switches.
2. Section 16001 - General Electrical Requirements

1.3 SYSTEM DESCRIPTION:

A. System shall be intelligent, addressable automatic fire alarm system consisting of control panel, power supplies, alarm initiating devices, alarm indicating devices, and off-site communicating devices.

B. Performance Requirements:

1. Operation of manual station or automatic activation of any smoke detector, heat detector, or sprinkler flow device shall -
    a. Cause system evacuation devices to operate.
    b. Indicate zone in alarm on control panel.
    c. Indicate zone in alarm on remote annunciator (if provided).
    d. Initiate off-site alarm notification system (if provided).
    e. Shut down all supply fans operating at 2000 CFM (if any) and over.
    f. Close all fire/smoke dampers (if any).
2. System shall return to normal when operated device is returned to normal and control panel is manually reset, except alarms may be silenced as specified below.
3. Alarm may be silenced by switch in control panel.
    a. Ring Back Feature - When silenced, this shall not prevent the resounding of subsequent alarms if another zone should alarm.
4. When alarms are silenced, zone indicating red LEDs on control panel and remote annunciator shall remain on until operated device is returned to normal and control panel is manually reset.

5. Green pilot LED shall normally be on indicating that system is receiving normal power. Failure of normal power shall cause this LED to extinguish.
6. Amber trouble LED and trouble alarm, operating together, shall signal trouble condition.
    a. Following conditions shall signal trouble condition -
        1) Failure of normal power.
        2) Opens or short circuits on indicating circuits.
        3) Disarrangements in system wiring.
        4) Control panel circuit board removal.
        5) Ground faults.
    b. Trouble silencing switch shall silence trouble alarm which shall be arranged so trouble LED shall remain lit until system is restored to normal. As ring-back feature, trouble alarm shall resound as reminder to return silencing switch to normal position.
7. Supervisory LED, separate from trouble LED, and alarm, operating together, shall signal operation of supervisory device, such as control valve tamper, low air pressure, and low temperature switches. Alarm silence switch shall operate in same manner as trouble alarm.

1.4 SUBMITTALS:

A. Shop Drawings

1. Shop drawings shall be prepared by authorized factory representative and include -
    a. Single line diagram of actual system showing interconnection of all modules, detectors, horns, panels, and wiring counts. Diagrams are to be drawn on sheet sizes consistent with the contract documents and performed in a good workmanlike manner. Typical riser diagrams are not acceptable.
    b. Complete wiring diagrams.
    c. Manufacturer's original catalog data and descriptive information on each piece of equipment to be used.

B. Quality Assurance Submittals

1. Provide instruction manual from Manufacturer which explains what is to be done in event of various indications.

1.5 QUALITY ASSURANCE:

A. Regulatory Requirements

1. System shall meet approval of authority having jurisdiction (AHJ).
2. Equipment, devices, and cable shall be UL or Factory Mutual listed for use in fire alarm systems.

B. Installation shall be in accordance with the following standards

1. NFPA 70-THE NATIONAL ELECTRICAL CODE
2. NFPA 72-Installation, Maintenance, and Use of Protective Signaling Systems 1990 Edition
3. NFPA 72E-INSTALLATION OF AUTOMATIC FIRE DETECTORS

C. GUARANTEE: All equipment and systems shall be guaranteed by the contractor for a period of one year following acceptance by the owner. The guarantee shall include all parts, labor, prompt field service, pickup, installation and delivery.

D. MANUFACTURER: Firms regularly engaged in the manufacturing of fire alarm and detection equipment and accessories of the types and sizes required.

E. INSTALLER: The contractor for the automatic fire alarm systems shall be a duly licensed fire alarm contractor by the state of Utah. The contractor must be regularly engaged in the installation, testing and maintenance of automatic fire alarm and detection systems. The contractor shall be fully familiar with all local conditions, codes and requirements.

F. PRIOR APPROVALS:

1. Any equipment proposed as equal, to that specified, shall conform to the standards indicated, and the manufacturer shall supply proof of having produced similar equipment that has been in satisfactory service for the past five years.
2. The contractor must obtain the engineers approval, in writing, ten working days prior to bidding equipment other than that specified. The manufacturers' name, model numbers, working samples of all proposed devices, UL test reports, three copies of working drawings, and engineering data shall be submitted to the engineer for his approval.

1.6 OWNER'S INSTRUCTIONS:

A. Instruct Owner's representative in proper operation and maintenance procedures.

1.7 TEST AND REPORTS:

A. The contractor shall perform all of the electrical and mechanical tests required by the equipment manufacturer. All test reports shall be submitted as part of the Acceptance Test Procedure required by these specifications.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS / INSTALLERS:

Manufacturer	Installer / Telephone
Bosch / Radionics	American Security & Fire, Inc. / (801) 263-6002
Cerberus Pyrotronics	Siemens / (801) 571-9601
Edwards Systems Technology	Lassco / (801) 521-3421 &
	Wasatch Electric / (801) 487-4511
	State Fire Sales and Service / (801) 288-2100
Fire Control Instruments	Nelson Fire Systems / (801) 484-9992
Gamewell	Nelson Fire Systems / (801) 484-9992
Mirtone	BEST / (801) 352-0743
Notifier	Fire Protection Services Corp. / (801) 363-9696
Silent Knight	Alarm Tech / (801) 568-6757
Simplex	Simplex / (801) 262-4242
Thorn / Autocall	Grinnell / (801) 262-9406

2.2 COMPONENTS:

A. Equipment and accessories furnished under terms of this Specification shall be standard products of single manufacturer, or include written statement by Control Panel Manufacturer confirming compatibility of components and inclusion of these components under system warranty.

B. Control Panel

1. Listed under UL Standard 864.
2. Solid state modular design with flush or semi-flush mounting.
3. Control functions shall be behind locked door with annunciating devices visible through door. Single key shall operate all keyed functions in system. Provide three keys.
4. Each zone shall be electrically supervised in accordance with wiring style specified.
5. Provide integral surge protection.
6. Make provisions for remote annunciator.
7. Make provisions for connection to off-site alarm notification system. Provide separate dry contacts for alarm and supervisory/trouble alarms.
8. Power Supply –
   a. Provide green LED indication of normal power supply.
   b. Loss of normal power shall activate trouble alarm.
   c. Meet requirements of and size in accordance with UL Standard 1481 and NFPA 72.
   d. Include standby batteries, charger, and automatic transfer equipment.
9. Visual Annunciation –
   a. Separate indication on each zone for alarm, trouble, or supervisory conditions.
   b. Visual indication shall be by LED lights or other easily identifiable method.
   c. Zones shall be permanently custom labeled by zone name, not number.
   d. Fault or trouble condition on any zone shall not affect any other zone.

10. Audible Horn Alarm Annunciation –
    a. Provide separate and distinct alarm signals for alarm and trouble conditions.
    b. Alarm signal shall also operate strobe lights, if specified.
    c. Provide alarm silence switches at control panel.
    d. Trouble alarm shall be horn integral to control panel.
    e. Supervisory alarm may be same audible alarm as trouble alarm, but with separate visual annunciation.
    f. Provide weatherproof (WP) enclosure for devices located outside or in damp or wet locations

C. Off-Site Alarm Notification System

1. Provide telephone conduit from telephone terminal board to fire alarm control panel.
2. Owner will arrange for dialer system equipment and monitoring connection contract.

D. Alarm Initiating Devices

1. Automatic Smoke Detectors –
   a. Photoelectric type.
   b. Listed under UL Standard 268.
   c. Provide visual indication of alarm on unit when normally pulsed supervisory LED glows continuously.
   d. With addressable base.
2. Heat Detectors –
   a. Non-settable 135 deg F fixed temperature.
   b. Provide visible indication that device has operated.
   c. Listed under UL Standard 521.
   d. With addressable base.
3. Sprinkler & Flow Devices –
   a. Water flow switches and valve tamper switches furnished and installed under Division 15.
   b. Provide addressable monitor module.
4. Manual Fire Alarm Boxes –
   a. Non-coded and double-action requiring two actions to initiate alarm. Breakable glass type are not approved.
   b. Box shall mechanically latch when actuated and require key to reset. Key shall match control panel door lock.
   c. With addressable base.
5. Duct Smoke Detectors –
   a. Furnished and installed under this section. Shall be UL 268A listed and equipped with two FORM "C" contacts and sampling tubes spanning the entire width of the duct.
   b. With addressable base.

E. Alarm Indicating Devices

1. Combination Horn/Strobe –
   a. Wall mounted flush or semi-flush.
   b. Non-coded audible output of 90 dB minimum at 10 feet.
   c. Integrally mounted flashing light unit with block letters 'FIRE'. Minimum light intensity of 75 candela and flash rate between one and three Hertz.
   d. Listed under UL Standards 464 and 1971.

F. Accessory Devices

1. Door Hold/Release Devices –
   a. Door release units shall be electrically operated magnetic devices which hold doors open until released by main control panel.
   b. Provide adequate backing/support for door holder.

G. Relays

1. Fan shut down relays –
   a. Provide fan shut down relays in locations as shown on drawings as required to shut down supply fans over 2000 CFM upon alarm.
   b. Provide addressable control modules.
2. Fire/smoke Damper relays-

a. Provide relay as required to activate 120 volt fire/smoke dampers upon alarm.
b. Provide addressable control modules.

2.3 BUILDING FIRE ALARM MAP:

A. A building fire alarm map shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install the building map adjacent to the fire alarm panel. Provide a high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall have a clear center for viewing the CAD fire alarm drawing. Edges of the sign shall be colored to match the building interior. The building map shall indicate zoning by the use of five different colors, minimum.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install fire alarm and detection systems as indicated, in accordance with equipment manufacturer's written instructions, and complying with applicable portions of NEC, NFPA and NECA's "Standard of Installation".

B. Label zone indicators on control unit indicating location and type of initiating device, i.e., CORRIDOR SMOKE, VALVE TAMPER, AIR SYSTEM SMOKE, etc. Labels shall be engraved plastic laminate, or other permanent labelling system as supplied by Control Unit Manufacturer.

C. Raceway: Install fire alarm conductors in raceway. Fire alarm system conductors from different zones may be combined in common conduit. Make certain that raceway size and wire quantity, size, and type is suitable for equipment supplied and is within NEC standards. No wiring other than that directly associated with the fire alarm and detection systems shall be permitted inside the fire alarm conduits. All conduit, mounting boxes, junction boxes, panels, detectors, alarm devices, etc. shall be mounted and fastened with appropriate fittings to insure positive grounding throughout the entire system.

D. Install conductors, and make connections, to water flow switches and valve tamper switches.

E. Loop wires through each device on zone for proper supervision. Tee-taps not permitted. Wiring splices are to be avoided to the maximum extent possible, if needed, they must be made only in junction boxes. Transposing or changing wire color coding of the wires shall not be permitted.

F. Provide dust protection for installed and existing (if any) smoke detectors until finish work is completed and building is ready for occupancy.

G. Protect conductors from cuts, abrasion and other damage during construction.

H. Minimum conductor size shall be 14 AWG unless otherwise specified. Shielded and/or stranded conductors shall be provided where recommended by manufacturer.

I. Do not install ceiling mounted detectors within 3 feet of air discharge grills. Coordinate with other trades as required.

J. Do not install manual fire alarm boxes close to light switches.

K. Post copy of wire identification list inside fire alarm panel door or other area accessible to fire alarm service personnel.

L. The control and other panels shall be mounted with sufficient clearance for observation and testing.

M. All fire alarm junction boxes shall be identified with zone number and red paint for easy identification.

3.2 TESTING AND MAINTENANCE :

A. Final test and inspection shall be held in the presence of the engineer, the owner, and the Utah State Fire Marshall to their satisfaction. The fire alarm equipment supplier shall conduct the tests. The contractor shall supply the personnel and equipment necessary to conduct the testing at no additional cost to the owner.

1. Two-way radios, approved type of smoke as recommended by the manufacturer and hair dryer (or other means to set of heat detectors) and 3 K ohm resistor to test ground fault shall be provided by electrical contractor or fire alarm system representative.
2. Each detector shall be tested and each zone shall be opened to test Class A loop and ground fault.
3. Test operation of trouble annunciation on each circuit.
4. Perform complete testing of control panel functions.

3.3 IDENTIFICATION:

A. All fire detection devices shall be marked in nominal ½" high letters with the zone and device number (for example 1-20, indicates zone 1, device number 20).

END OF SECTION 16721

Camp Williams Readiness Center
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SECTION 16850 - TELEVISION EQUIPMENT

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 master antenna television systems using a community antenna television cable service and an off-air antenna system as the signal source.

1.3 DEFINITIONS

A. CATV: Community antenna television.

B. MATV: Master antenna television.

C. NTSC: National television system committee.

D. RF: Radio frequency.

1.4 SUBMITTALS

A. Product Data: Include detailed manufacturer's specifications for each component specified. Include data on features, ratings, and performance.

B. Shop Drawings: For television equipment.

1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Product Certificates: Signed by manufacturers of television equipment and components certifying that products furnished comply with requirements.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with requirements.

E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements of installed systems.

F. Maintenance Data: For television equipment and components to include in maintenance manuals. In addition to requirements specified in section 16000 - General Electrical Provisions, include the following:

1. Detailed operating instructions covering operation under both normal and abnormal conditions.
2. Routine maintenance requirements for system components.

3. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the television equipment manufacturer, for both installation and maintenance of units required for this Project, to supervise installation of the system.

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 seismic controls for electrical and electronic equipment that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: 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 Part 3.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of television equipment and are based on the specific system indicated. Other manufacturers' products complying with requirements may be considered. Refer to Division 1 Section "Substitutions."

E. 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.

F. Comply with NFPA 70.

G. Comply with 47 CFR 15, 17, and 76.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: System components are equipped and rated for the environments where installed.

1. Service Conditions for Indoor Equipment: Rate equipment for continuous operation under the following environmental conditions, unless otherwise indicated:
   a. Temperature: 32 deg F (0 deg C) to 122 deg F (50 deg C).
   b. Relative Humidity: 0 to 95 percent.

1.7 COORDINATION

A. Coordinate Work of this Section with requirements of CATV service provider.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Blonder Tongue Laboratories, Inc.
2. Channell Company.
3. General Instrument Corp.; Jerrold Div.
4. Multiplex Technology, Inc.
5. Pico Macom, Inc.

2.2 TELEVISION SYSTEMS

A. Components: Modular plug-in, heavy-duty, industrial- or commercial-grade units.

B. Equipment: Silicon-based, solid-state, integrated circuit devices.

C. Power Supply Characteristics: Devices shall be within specified parameters for ac supply voltages within the range of 105 to 130 V.

D. Protect signal cables and connected components against transient-voltage surges by suppressors and absorbers designed specifically for the purpose.

E. RF and Video Impedance Matching: Signal-handling components, including connecting cable, shall have end-to-end impedance-matched signal paths. Match and balance devices used at connections where it is impossible to avoid impedance mismatch or mismatch of balanced circuits to unbalanced circuits.

2.3 MATV EQUIPMENT

A. Description: Signal-source components, signal-processing and amplifying equipment, distribution components, and interconnecting wiring. System shall receive signals from sources, amplify and process them, and distribute them to outlets for receiving sets. UHF channels indicated to be received are translated to VHF channels before distribution to outlets.

B. Identification of Signal Sources and Channels Distributed: Channels 2,4,5,7,9,11,13 & 14.

C. MATV System Functional Description: System shall receive signals from sources, amplify and process them, and distribute them to outlets for receiving sets. UHF channels indicated to be received are translated to VHF channels before distribution to outlets.

D. MATV System Qualitative Performance Requirements: Reception quality of color-television program transmissions at each system outlet from each designated channel and source shall be equal to or superior than that obtained with performance checks specified in "Field Quality Control" Article, using a standard, commercial, cable-ready, color-television receiver.

E. MATV System Quantitative Performance Requirements: Level and quality of signal at each outlet from each designated channel and source shall comply with Specifications below when tested according to NCTA-02 or 47 CFR 76.

2.4 MATV ANTENNAS

A. Off-Air, Mast-Mounted Antennas: Single-channel or broadband type, constructed of high-strength anodized aluminum.

1. Elements: Internally dampened against such mechanical vibration as may occur in service.
2. Ends of Crossarms and Elements: Sealed.
3. Mounting and Connecting Hardware: Corrosion proof.
4. Frequency Range: Matched to source frequencies.

2.5 MATV COMPONENTS

A. Head-End Equipment: Include filters, processors, broadband and single-channel amplifiers combining networks, power supplies, and other equipment as required to provide specified performance. House units in standard 19-inch (483-mm) electronic equipment cabinet.

B. Signal Power Splitters and Isolation Taps: Metal-enclosed directional couplers with brass connector parts. Where installed in signal circuits used to supply cable-powered amplifiers, power throughput capacity shall exceed load by 25 percent minimum.

C. Signal Traps: Packaged filters tuned to interference frequencies encountered in Project.

D. Attenuators: Fixed to balance signal levels.

E. Terminating Resistors: Enclosed units rated 0.5 W and matched for coaxial impedance.

F. Outlets: Flush, female type with metallic parts of anodized brass, beryllium copper, or phosphor bronze.

1. Wall Plates: Match materials and finish of power outlets in the same space.
2. Attenuation: Less than 0.1 dB.
3. Voltage Standing Wave Ratio: Less than 1.15 to 1.

2.6 SIGNAL TRANSMISSION COMPONENTS

A. Cable: Coaxial cable elements have 75-ohms nominal impedance and are 100 percent factory-sweep tested to meet or exceed requirements of NFPA 70, Articles 725, 800, and 820. Cables run in environmental air spaces are listed for use in plenums.

1. MATV Indoor Branch Cable: RG-6/U; cellular-polyethylene dielectric, bare-copper braid shield with 95 percent minimum shielding factor, No. 18 AWG solid copper-clad-steel conductor; and PVC jacket.

B. MATV Coaxial Cable Connectors: Type F, 75 ohms.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cable. Check raceways, cables trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for antenna to verify actual locations of cable connections before antenna installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wiring Method: Install cables in raceways, except in accessible indoor ceiling spaces and attics, and as otherwise indicated. Conceal raceways and wiring except in unfinished spaces.

B. Wiring at terminal board: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

C. Pulling Cable: Do not exceed manufacturer's recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

D. Exposed Cable: Install parallel to building lines, follow surface contours, and support the cable according to manufacturer's written instructions. Do not run adjacent and parallel to power or data cables.

E. Equalizing Video Signals: Where system performance may be degraded in certain operating modes, revise component connections and install video distribution amplifiers and attenuators as required to provide a balanced signal across the system.

F. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. 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.

G. Grounding: Provide independent signal circuit grounding recommended by manufacturer.

3.3 MATV SYSTEM INSTALLATION

A. Head-End Equipment: Mount in electronic equipment the types of cabinets recommended by manufacturer. Group related items in methodical sequence.

B. Arrange equipment to facilitate access for maintenance and to preserve headroom and passage space.

C. MATV Antennas: Align antenna elements to achieve maximum signal level and quality.

D. MATV Antenna-Supporting Structure: Increase antenna height as required to obtain signal strength needed for specified system performance.

1. Attachment to Building Joists (Attic): Use 0.375-inch- (10-mm-) minimum lag bolts for attachment to wood.
2. Grounding: Comply with NFPA 780, "Installation of Lightning Protection Systems," unless more stringent requirements are indicated.

E. Antenna Cable Entrance: Use entrance fittings and seal and waterproof penetrations of the building envelope.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation and supervise pretesting, testing, and adjusting of television equipment.

B. Inspection: Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

C. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Replace malfunctioning or damaged items. Retest until satisfactory performance and conditions are achieved. Prepare television equipment for acceptance and operational testing as follows:

1. Off-Air, Mast-Mounted Antenna Sources: Connect the receiver to the down lead of a 10-element, single-channel antenna, tuned and oriented to optimize reception for the channel and placed at the system antenna's location. Alternatively, connect the receiver to a single-channel video amplifier connected to the down lead of the above single-channel antenna.
2. CATV Sources: Connect the receiver to an agile demodulator or CATV set-top converter at the CATV service entrance to the facility.

D. Test Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

E. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

F. MATV System Acceptance Tests: Include the following, performed according to NCTA-02:

1. Instrumentation: Use a field-strength meter rated for minus 40-dB mV measuring sensitivity and a frequency range of 54 to 812 MHz, minimum. Provide documentation of recent calibration against recognized standards.
2. Signal Level: Use a field-strength meter to measure signal levels at MATV system outlets. Readings on each of the channels designated to be received must be within specified limits.
3. Signal-to-Noise-Ratio Test: Use a field-strength meter to make a sequence of measurements at the output of the last distribution amplifier or of another agreed-upon location in system. With system operating at normal levels, tune meter to the picture carrier frequency of each of the designated channels in turn and record the level. With signal removed and input to corresponding head-end amplifier terminated at 75 ohms, measure the level of noise at the same tuning settings. With meter correction factor added to last readings, differences from first set must not be less than 45 dB.
4. Picture-Quality Test: Connect a standard TV receiver to each system outlet and observe picture quality on designated channels. No evidence of cross-channel intermodulation, ghost images, or beat interference should appear.

G. Qualitative and Quantitative Performance Tests: Demonstrate reception quality of color-television program transmissions at each system outlet from each designated channel and source. Quality shall be equal to or superior than that obtained with performance checks specified below, using a standard, commercial, cable-ready, color-television receiver. Level and quality of signal at each outlet and from each designated channel and source shall comply with the following Specifications when tested according to NCTA-02 or 47 CFR 76:

1. RF Video Carrier Level: Between 3 and 12 dB mV.
2. Relative Video Carrier Level: Within 3 dB to adjacent channel.
3. Carrier Level Stability, Short Term: Level does not change more than 0.5 dB during a 60-minute period.
4. Carrier Level Stability, Long Term: Level does not change more than 2 dB during a 24-hour period.
5. Broadband Frequency Response: More than the 54- to 220-MHz frequency range, signal amplitude is plus or minus 3 dB, maximum.
6. Channel Frequency Response: Across any 6-MHz channel in the 54- to 220-MHz frequency range, referenced to video carrier, signal amplitude is plus or minus 1 dB, maximum, unless otherwise indicated.
7. Carrier-to-Noise Ratio: 45 dB or more, unless otherwise indicated.
8. RF Visual Signal-to-Noise Ratio: 43 dB or more.

H. Record test results.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.6 CLEANING

A. Clean installed items using methods and materials recommended by manufacturer.

B. Clean MATV system components, including antennas and supports, head-end equipment, distribution components, and outlets.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain television equipment.

1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
2. Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.
3. Demonstrate programming and tuning of satellite receivers.
4. Review data in maintenance manuals.
5. Schedule training with Owner, through Architect, with at least seven days' advance notice.

3.8 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested by Owner within one year of date of Substantial Completion, provide on-site assistance in tuning and adjusting the system to suit actual occupied conditions and to optimize performance. Provide up to two adjustments at Project site for this purpose, without additional cost.

END OF SECTION 16850

Camp Williams Readiness Center
DFCM Project No. 04042480

SECTION 16770 - AUDIO SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope of Work: This specification defines certain audio systems to be installed in the assembly hall, classrooms, corridors and restrooms. Utah National Guard 144th Company Readiness Center, , Riverton, Utah.

B. Definition of Terms:

1. The term "Owner" shall refer to Utah National Guard 144th Company Readiness Center, , Riverton, Utah
2. The term "Architect" shall refer to ajc architects.
3. The term "Consultant" shall refer to Sound Design International Incorporated.
4. The term "Installer" shall refer to the Systems Contractor who has responsibility for performance of the work specified herein.
5. The term "approved", where used in conjunction with the Consultant's action on the Installer's submittals, applications, and requests, is limited to the Consultants duties and responsibilities as stated in General Supplementary Conditions.
6. The term "A/R" indicates components quantities "as required".
7. The term "custom" indicates systems or components that shall be fabricated by the Installer based on these specifications and drawings.
8. The term "directed," "requested," "authorized," "selected," "approved," "required" and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.
9. The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
10. The term "Furnished by Owner" refers to Owner Furnished Equipment. Coordinate the integration of existing components or new components, provided by the Owner into the system. Provide all required mounting hardware, equipment cabinet panels, cable, connectors, etc. to ensure proper operation of the Owner Furnished Equipment systems as specified.
11. The term "future" indicates equipment that will be added to the systems by the Owner or Owner representative at a later date. Provisions shall be made for this equipment.
12. The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
13. The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
14. The term "NIC" refer to work or equipment which is "not in contract" or not covered in this section.
15. The term "or equal" indicates equal in materials, size, color, design, function, efficiency of specified and conforming with base bid manufacturer and model.

16. The term "provide" means "to furnish and install, complete and ready for the intended use."
17. The term "Regulations" includes laws, ordinances, statues, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry to control performance of the Work.
18. The term "shall" is mandatory; the term "will" is informative; the term "should" is advisory; and the term "provide" means furnish and install.
19. The term "substitutions" is requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Installer after award of the Contract are considered requests for "substitutions."

C. Section Includes:

1. Supply and install a turnkey system, to include all equipment and materials, whether specifically mentioned herein or not, to ensure a complete and operating system.
2. Generate all submittal information for the complete fabrication, installation and wiring of the system. Provide the on-site installation and wiring, and provide on-going supervision and coordination during implementation.
3. Provide for the initial adjustment of the systems as herein prescribed and provide all test equipment for the system checkout and acceptance tests. Two weeks prior to the systems acceptance tests, submit an initial testing and tuning report to be reviewed by the Consultant showing methods and results for tests performed.
4. Provide on-the-job training in the operation and maintenance of the systems for personnel designated by the Owner.
5. Provide one year warranty for all systems installed, as specified.

D. Related Work: Equipment and materials provided and installed by others, unless otherwise indicated in this section or on the related drawings, and specification sections, will include the following:

1. Structural work, wall openings, fire prevention and safety devices, rough and finished trim, painting and patching, drapes, carpets, floor coverings, glazing, and acoustical treatments.
2. Furniture, desks, chairs, and casework.
3. Conduits, wireways, connection boxes, pull boxes, junction boxes, ceiling loudspeaker enclosure, and outlet boxes permanently installed in walls, floors, and ceilings.
4. Electrical breaker panels required to power the audio equipment.
5. Lighting fixtures, dimmers, power receptacles outlets, and interconnecting wiring for these circuits.

1.2 REFERENCES

A. Codes: Work shall be performed in accordance with all applicable requirements of all governing codes, rules and regulations including the following minimum standards, whether statutory or not:

1. City, and other local codes and requirements
2. Federal Communications Commission (FCC)
3. National Electric Code (NEC)
4. National Fire Protection Association (NFPA)
5. Uniform Building Code (UBC)

B. Standards: Equipment and materials specified shall conform to the current edition of the following standards where applicable:

1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. Electrical Testing Laboratories (ETL)
4. Electronic Industries Association (EIA)
5. International Standards Organization (ISO)
6. National Association of Broadcasters (NAB)
7. National Electrical Manufacturer's Association (NEMA)
8. National Fire Protection Association (NFPA)
9. Society of Motion Picture and Television Engineers (SMPTE)
10. Sound Systems Engineering, 2nd Ed., Davis and Davis, Howard W. Sams Co., 1987
11. Underwriters' Laboratories (UL)

C. Systems Contract Documents: These specifications and all drawings referred to herein are furnished with and are integral parts of this system construction documents. The specifications and drawings shall remain the property of the Owner and shall be returned by all unsuccessful bidders.

D. Specification Information Requests: Direct any requests for clarification, substitution, or changes in these specifications or drawings to the Architect.

E. Unit Prices: Unit prices, as derived from the quotations in the Schedules of Values, shall be used for all adjustments to the contract price.

1.3 SHOP DRAWING SUBMITTALS

A. Prior to Fabrication:

1. All panels, plates, and designation strips, including details and samples relating to terminology, engraving, finish and color.
2. All custom designed consoles, tables, carts, support bases, and shelves.
3. Schematic drawings of all custom circuitry.
4. All unusual equipment modifications.
5. Equipment cabinet layout.

B. Prior to Assembly and Installation:

1. System functional block drawings: For video, audio, and control systems, include all equipment names and model numbers (i.e., "Program Amplifier - QSC 3350"). Clearly label each item of equipment shown on the drawing with the manufacturer's terminal number or input/output designation (e.g., "Mic 1 In", or "Record Out Left").
2. Equipment cabinet drawings: Provide scaled equipment cabinet elevations and full scale patch bay drawings with proposed labeling. Labeling on the functional diagrams, equipment cabinet elevations, patch panels, and on the equipment controls shall be consistent and uniform.
3. Provide full scale drawings of all custom plates and panels indicating exact lettering, critical dimensions, and finish.
4. Equipment modification drawings: Include details of any modifications that modify or void manufacturers warranties.

5. Final schematic drawings of any custom circuitry: Include receptacle pin numbers and all component call-outs. Show details of any custom resistive combining networks, filters, or pads which may be required in the assembly. Show point-to-point wiring drawings for all control system modules and interfaces, and for all switches and relays in audio, video, or control systems.
6. Test Equipment: Provide a list of test equipment, including manufacturer, description and model number, of all equipment that is expected to be employed in the test and adjustment of the systems specified.

C. At the Completion of the Installation:

1. Notification: Provide written notification to the Consultant when initial checkout is complete, normal settings are documented, as-built and operational documentation are complete, and systems are available for final acceptance test by the Consultant. Provide a completed copy of the initial testing report.
2. Submit equipment manufacturer's operation and maintenance manuals for each piece of equipment.
3. Submit "as-built" drawings for all systems and any item indicated as "Custom".
4. Submit System Operation and Maintenance Manual:

1.4 QUALITY ASSURANCE

A. Insurance: Procure and maintain during the life of the contract, such comprehensive liability and property damage insurance as shall protect him and the Owner from claims for bodily injury, including death, and claims for property damage which may arise from the operations under this contract. Submit confirmation of this insurance with the bid.

B. Field Cooperation: Cooperate at all times, and to the fullest extent, with all trades during work in the building, to the end that lost time, work stoppages, interference, and inefficiencies do not occur.

1.5 DELIVERY, STORAGE AND HANDLING

A. Bear costs of all shipping to the site, and of all unusual storage requirements. Make appropriate arrangements, and coordinate with authorized personnel at the site, for the proper acceptance, handling, protection, and storage of equipment so delivered.

1.6 WARRANTY

A. Warranty the entire system for a minimum of one year from the date of system acceptance by the Owner. Component warranties shall be honored for the term established by the manufacturer, if greater than one year.

B. Activate all manufacturer's equipment warranties in Owner's name to commence on the date of acceptance. In the case of installer modified equipment, the manufacturer's warranty is normally voided. In such cases, provide the Owner with a warranty equivalent to that of the original manufacturer.

C. Replace defective materials and repair faulty workmanship within 72 hours of discovery at no cost to the Owner during the period of the warranty.

D. If, during the warranty period, any component is out of service for more than one week due to unavailability of parts or service, supply and install an identical new component. If an identical component is not available, substitute equivalent equipment, but only with approval of the Owner.

PART 2 - PRODUCTS

2.1 SUPPLIER / INSTALLERS

A. Pre-qualification of Sound Installers:

1. All Sound Installers submitting bids for the sound systems specified herein must be pre-qualified in writing by the Acoustical Consultant not less than 10 days prior to the bid opening. Sound Installers desiring to be pre-qualified other than those shown below, shall submit the required qualification statement of Paragraph 2.1.B.
   a. General Communications Inc.
      4332 South 500 West
      Salt Lake City, UT 84123
      (801) 266-5731
   b. Marshall Industries Inc.
      614 East 3900 South
      Salt Lake City, UT 84107
      (801) 266-2428
   c. Poll Sound
      4026 South Main Street
      Salt Lake City, UT 84107
      (801) 261-2500
   d. Bids submitted by non-pre-qualified bidders will not be accepted.

B. Sound Installer's Qualifications:

1. The work of this section will be contracted to a single firm, referred to as the Sound Installer for undivided responsibility.
2. The Sound Installer must be experienced in the installation of professional sound systems and have completed within the past five years at least five sound system projects of a size and scope comparable to the project described herein.
3. The Sound Installer shall have capabilities and in-house facilities for installation, shop fabrication and repair service of professional sound systems.
4. The Sound Installer shall have on his full-time payroll at least one staff engineer having five years minimum experience as an audio engineer. In place of a qualified staff engineer, the Sound Installer may retain a consulting engineer to direct the project. Prior to bid acceptance, the qualifications of the consulting engineer shall be submitted for the approval of the Consultant. Said staff or consulting engineer shall:
   a. Provide all technical liaison between the Sound Installer and the Consultant.
   b. Represent the Sound Installer at meetings and conferences, and be present at the job site for final inspection/
   c. Be responsible for supervision of all technical and engineering work required to execute the contract, and , in particular, approve and sign all shop drawings.

5. Must be a dealer or distributor of equipment included in bid and provide documents from manufacturers stating such.
6. Outline the general scope of past project, normal staffing levels, and union status of shop and field installation personnel.
7. List a minimum of three (3) projects of similar scope successfully completed, indicating the location, type of system installed, total contract amount, date completed, and include persons and telephone number to contact.
8. Submit confirmation of current state or local contracting licenses, as required to perform the work under this section.

2.2 EQUIPMENT

A. Provide equipment as specified in the Equipment List on the drawings.

B. Supply the latest model, available at the time of bidding, of each piece of equipment.

C. Materials: Supply materials and equipment that shall be new and shall meet or exceed the latest published specifications of the manufacturer in all respects.

2.3 CUSTOM FABRICATION

A. Project Information Label: Permanently mount, at the top facing edge of the equipment cabinets, an engraved plastic laminate plate, with filled lettering on contracting background. Plate shall identify "Design by Sound Design International Incorporated, Bountiful, UT Installation by: Installer, City, ST."

B. Labeling: Provide permanently mounted labels (Kroy or Brother) for each piece of equipment and every user-adjustable control and input on the audio equipment.

C. Equipment Cabinet Mount Adapters and Security Covers: Provide the appropriate factory or custom equipment cabinet mount adapters for all equipment installed in the audio equipment cabinet, whether specifically itemized or not. Provide security covers for all equalizers, crossovers, signal delays, and other adjustable signal processors.

D. System Functional Diagrams: Provide in the equipment cabinet reduced-size as-built functional diagrams for each control, audio and video system.

E. Seismic Safety: Mount and brace permanently installed equipment to the building structure to minimize potential damage to personnel or equipment from foreseeable seismic events. Physically bolt audiovisual equipment cabinets to the floor to prevent toppling. Brace hanging equipment such as loudspeakers both to minimize sway and to prevent detachment from the overhead structure.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that all electrical requirements including junction boxes, floor boxes, ceiling loudspeaker enclosures, cable, conduit and power circuits and receptacles are in place as shown on the drawings.

3.2 INSTALLATION

A. General: Include the delivery, unloading, setting in place, fastening to walls, floors, ceiling, counters, or other structures where required, interconnecting wiring of the system components, equipment alignment and adjustment, and all other work whether or not expressly required which is necessary to result in complete operational systems.

B. Physical Installation:

1. Firmly secure all equipment in place unless requirements of portability dictate otherwise.
2. Mount permanently and/or provide a mechanical index insuring precise alignment of the projected image of all optical projectors.
3. Provide adequate fastenings and supports with a safety load factor of at least three.
4. Secure plumb and square all boxes, equipment, etc.
5. Given consideration, not only to operational efficiency, but also to overall aesthetic factors in the installation of equipment and cable.

C. Cable Installation:

1. Mark all cables, regardless of length, with permanent, non-handwritten number of letter cable markers within six inches of both ends. There shall be no unmarked cables at any place in the system. Marking codes used on cables shall correspond to codes shown on drawings.
2. Furnish screw-type terminal blocks, boards, strips, or connectors, for all cables which interface with equipment cabinets, cabinets, consoles, or equipment modules. Terminate wires terminating at screw-type terminals with crimp-on lugs. "Telephone-style" punch-down blocks are not acceptable for signal or data wiring.
3. Group all cables according to the signals being carried. In order to reduce signal contamination, form separate groups for the following cables:
4. As a general practice, run all power cables, control cables, and speaker cables on the left side of an equipment cabinet as viewed from the rear. Run all other cables on the right side of an equipment cabinet, as viewed from the rear.
5. Cut all cables to the length dictated by the run. Provide the interconnecting cables with a service loop of appropriate length where needed.
6. Install no cable with a bend radius less than that recommended by the cable manufacturer.
7. Where plenum-rated cable is used, provide plenum-rated and approved tie-wraps and supports (Thomas & Betts # TYV525M, or approved equal).

D. Wall Plate Connectors:

1. Wall Plate Designation: Clearly label all wall mounted receptacle plates with alphanumeric identification of input type (i.e., mic, line, speaker, etc) and corresponding audio designation.

3.3 FIELD QUALITY CONTROL

A. Initial Tests and Measurements:

Before final adjusting and acceptance test are scheduled, perform system checkout. Furnish all required test equipment and perform all work necessary to determine and/or modify performance of the system to meet the requirements of this specification. Include the following:

1. Test all audio and control systems for compliance with the functional requirements and Performance Standards.
2. Adjust, balance, and align all equipment for optimum quality and to meet the manufacturer's published specifications.
3. Prepare and maintain documentation of all performance tests, including numerical values of established equipment settings, for reference by the Consultant during the System Acceptance Tests. Submit final results with the Operations and Maintenance Manual.
4. Install 1/8 " Brother or Kroy arrows as indicators for nominal operating positions of all rotary, slider, or switch controls available for operator adjustment. Provide multiple indicators, adequately distinguished, for controls having more than one nominal operating position.
5. Follow Electronic Industries Association Standards RS 219 and RS 160 in performing these tests.

B. Audio System:

1. Loudspeaker-Line Impedance: Measure the impedance at 250 Hz, 1 kHz and 4 kHz and the resistance of each loudspeaker line leaving the sound equipment cabinet with the line disconnected from its normal driving source. Record on single line riser diagram.
2. Hum and Noise Level:
   a. Measure the hum and noise levels of the overall system for each microphone input channel and line-level input channel.
   b. Adjust gain controls for optimum signal-to-noise ratio so that full amplifier output will be achieved with 0 dBm at a line-level input.
   c. Terminate line-level inputs with shielded resistors of 150 and 600 ohms, respectively, for these measurements.
   d. Disconnect the loudspeaker lines and terminate the power-amplifier outputs with power resistors for these measurements. The value of the load resistor shall be within 5% of the nominal load impedance of the amplifier under test. The power rating of the resistor shall equal the power rating of the amplifier.
3. Frequency Response of the System:
   a. Measure the frequency response from input to every output.
   b. Installations with equalizers shall meet following performance parameters as measured in 1/3 octave bands. From 10 Hz to 2 kHz, flat within plus or minus 2 dB. Above 2 kHz, slope down along an approximate 3 dB per octave slope to 8 kHz.
   c. Programmable Equalizers: Provide necessary controller with full audio spectrum display for the adjustment of all programmable equalizers during system checkout. Do not provide any equalizer programmers with the systems.
4. Uniformity of Coverage: Measure octave band of pink noise test signal, centered at 4 kHz, played through loudspeaker system. Record at least 8 locations in the audience area.
5. Power-Output and Signal-Level Adjustment within System:
   a. Measure the electrical distortion of the overall system for each line-level input channel.

b. Adjust gain control as for the tests specified herein.
c. Apply a 1-kHz sine-wave signal from an oscillator having less than 0.5% total harmonic distortion at the input tested, at a level required to produce full amplifier output. Note that a pad with 150-ohm output impedance is required for driving the microphone-level input in accordance with the EIA standard.
d. Use a distortion analyzer to measure the output level and the total harmonic distortion of the amplification and control equipment. In the absence of a distortion analyzer, a high input impedance measuring device such as a DMM may be used to measure the output level. Lack of clipping or apparent deformation of a sine-wave input signal at the power-amplifier output, as seen on the oscilloscope, may serve as evidence that distortion of amplification and control equipment is within acceptable limits, subject to review by the Consultant.
e. Make all measurement with loads actually incurred in the system operation. Power-amplifier loads shall be power resistors equal to the nominal load impedance of the output terminals used in the system.

6. Loudspeaker Polarity
   a. Perform polarity checks of loudspeaker lines by means of a polarity tester of use DC source at one end of each line and a voltmeter at the other end. Loudspeaker lines shall be identically polarized with respect to color coding.
   b. Test polarity of the loudspeakers using a sine-wave test signal warbled about 500 Hz. The listener shall be located on axis of the loudspeaker. Switch the loudspeakers from nominally in polarity to nominally out of polarity with respect to the selected loudspeaker. With the loudspeakers in proper polarity, the quality and clarity of the music or speech should be greater, and the warble test signal should clearly come to the surrounding space from the loudspeaker.
7. Freedom From Parasitic Oscillation and Radio-Frequency Pickup:
   a. With systems set up for each mode of operation specified in the functional requirements, check to ensure that all systems are free from spurious oscillation and radio-frequency pickup, both in the absence of any audio input signal and also when the system is driven to full output at 100 Hz.
   b. Employ an oscilloscope having at least 5 MHZ bandwidth for these checks.
   c. Apply show sine-wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power-amplifier output voltage to each system. Listen carefully for buzzes, rattles and objectionable distortion.
   d. Correct any causes of these defects unless the cause is clearly from other than the sound amplification system's equipment and installation, in which case bring the cause to the attention of the Consultant.
8. Audio Test Signal Paths: Verify operation from all source inputs (for microphones, audio tape units, video tape units, etc.) Through all distribution amplifiers, mixers switchers, etc., to all signal destinations.

3.4 OWNER TRAINING

A. Provide on-the-job training by a suitable qualified instructor, to designated personnel, to instruct them in the operation and maintenance of the systems.
B. Arrange with the equipment manufacturer for such instruction, at no additional cost, in the event qualified instructors are not available on staff.
C. Schedule all training, after the systems are operational, but before the acceptance tests. Provide a minimum of 2 hours of training on the systems included in this specification.

D. Provide two copies of video recorded operation and maintenance instructions (VHS format) as described above. Demonstrate actual maintenance procedures for all equipment and systems installed. Demonstrate operation of all systems, including initial start-up.

3.5 SYSTEM ACCEPTANCE TESTS

A. System acceptance tests shall not be performed until the initial system checkout has been completed. The system acceptance tests shall be supervised by the Consultant and shall consist of the following:

1. Take a physical inventory of all equipment on site and compare to equipment lists in the contract documents.
2. Demonstrate the operation of all system equipment.
3. Both subjective and objective tests will be required by the Consultant to determine compliance with the specifications. Provide test equipment specified by the Consultant for these tests.
4. Provide all final, "as-built" drawings, manuals, video tapes (VHS format) and other required documents.

B. In the event further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the Consultant.

1. If the need for further adjustments becomes evident during the demonstration and testing, continue work until the installation operates properly. Included in the continued work shall include, but not be limited to, changes to or installation of resistive pads, readjustment of loud speaker aiming, adjustment of system equalizers, programming changes to the control system, if in the judgement of the Consultant, these adjustments are required.
2. If acceptance of the system is delayed because of defective equipment or because the equipment does not fulfill this specification, reimburse the Consultant for all time and expenses of the Consultant for these tests during any extensions of the acceptance-testing period.

3.6 CLEANUP AND REPAIR

1. Upon completion of the work, remove all refuse and rubbish from and about the premises daily, and shall leave the relevant areas and equipment clean and in an operational state. Repair any damage caused to the premises by the installation activities, at no cost to the Owner.

3.7 PROTECTION OF WORK

1. During the installation, and up to the date of final acceptance, protect finished and unfinished work against damage and loss. In the event of such damage or loss, replace or repair such work at no cost to the Owner.