UTAH STATE DEVELOPMENT CENTER

BOILER REPLACEMENT

PROJECT # 08194410

State of Utah
Division of Facilities Construction & Management

T A B L E o f C O N T E N T S

PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

D I V I S I 0 N 00: P R O C U R E M E N T A N D C O N T R A C T I N G R E Q U I R E M E N T S

PROCUREMENT REQUIREMENTS

NOT INCLUDED IN THIS MANUAL – PROVIDED BY OWNER

SPECIFICATIONS GROUP

GENERAL REQUIREMENTS SUBGROUP

D I V I S I 0 N 01: G E N E R A L R E Q U I R E M E N T S

01100 SUMMARY

01300 ADMINISTRATIVE REQUIREMENTS

01400 QUALITY REQUIREMENTS

01500 TEMPORARY FACILITIES AND CONTROLS

01600 PRODUCT REQUIREMENTS

01700 EXECUTION REQUIREMENTS

FACILITY CONSTRUCTION SUBGROUP

D I V I S I O N 02: E X I S T I N G C O N D I T I O N S

NO REQUIREMENTS

D I V I S I O N 03: C O N C R E T E

03 1000 C O N C R E T E F O R M I N G A N D A C C E S S O R I E S

03 1511 ANCHORS & INSERTS

03 2000 C O N C R E T E R E I N F O R C I N G

03 2100 REINFORCING STEEL

03 3000 C A S T – I N – P L A C E C O N C R E T E

03 3111 NORMAL WEIGHT STRUCTURAL CONCRETE

03 9000 C O N C R E T E R E S T O R A T I O N A N D C L E A N I N G

03 9210 PARGE COAT

DIVISION 04: MASONRY

04 0000 MASONRY

04 0513 CEMENT AND LIME MASONRY MORTARING
04 0516 MASONRY GROUTING
04 0520 MASONRY REINFORCING
04 0523 MASONRY ACCESSORIES

04 2000 UNIT MASONRY

04 2223 ARCHITECTURAL CONCRETE UNIT MASONRY

DIVISION 05: METALS

05 0000 METALS

05 0503 SHOP-APPLIED METAL COATINGS
05 0523 METAL FASTENINGS

05 1000 STRUCTURAL METAL FRAMING

05 1223 STRUCTURAL STEEL FOR BUILDINGS

05 3000 METAL DECKING

05 3123 STEEL ROOF DECKING
05 3133 STEEL FORM DECKING

05 5000 METAL FABRICATIONS

05 5113 METAL STAIRS
05 5133 METAL LADDERS
05 5136 CATWALKS
05 5214 GALVANIZED STEEL PIPE & TUBE RAILINGS
05 5215 STAINLESS STEEL CORNER GUARDS
05 5871 METAL BRACKETS

DIVISION 06: WOOD, PLASTICS, AND COMPOSITES

06 0000 WOOD, PLASTICS, AND COMPOSITES

06 0573 PRESERVATIVE WOOD TREATMENT

06 1000 ROUGH CARPENTRY

06 1011 WOOD FASTENINGS
06 1100 WOOD FRAMING

06 2000 FINISH CARPENTRY

06 2001 COMMON FINISH CARPENTRY REQUIREMENTS
06 2024 DOOR, FRAME, AND FINISH HARDWARE INSTALLATION

06 4000 ARCHITECTURAL WOODWORK

06 4001 COMMON ARCHITECTURAL WOODWORK REQUIREMENTS
06 4005 PLASTIC LAMINATE

06 4110 CUSTOM CASEWORK

06 6000 PLASTIC FABRICATIONS

06 6413 PLASTIC PANELING

DIVISION 07: THERMAL AND MOISTURE PROTECTION

07 1000 DAMPPROOFING AND WATERPROOFING

07 1113 BITUMINOUS DAMP-PROOFING
07 1350 FOUNDATION DRAINAGE & WATER-PROOFING
07 1352 MODIFIED BITUMINOUS SHEET WATERPROOFING / BELOW-GRADE

07 2000 THERMAL PROTECTION

07 2113 BOARD INSULATION
07 2116 BLANKET INSULATION
07 2123 LOOSE FILL INSULATION
07 2613 VAPOR RETARDERS

07 5000 MEMBRANE ROOFING

07 5419 POLYVINYL-CHLORIDE ROOFING / PVC

07 6000 FLASHING AND SHEET METAL

07 6210 GALVANIZED STEEL FLASHING & TRIM

07 7000 ROOF AND WALL SPECIALTIES AND ACCESSORIES

07 7233 ROOF HATCHES

07 9000 JOINT PROTECTION

07 9213 ELASTOMERIC JOINT SEALANTS

DIVISION 08: OPENING

08 1000 DOORS AND FRAMES

08 1213 HOLLOW METAL FRAMES
08 1313 HOLLOW METAL DOORS

08 3000 SPECIALTY DOORS AND FRAMES

08 3362 SECTIONAL OVERHEAD DOORS

08 5000 ALUMINUM WINDOWS

08 5240 ALUMINUM FRAMED WINDOW

08 7000 HARDWARE

08 7101 COMMON FINISH HARDWARE REQUIREMENTS
08 7102 HANGING DEVICES
08 7103 SECURING DEVICES
08 7104 OPERATING TRIM
08 7106 CLOSING DEVICES
08 7107 PROTECTIVE PLATES AND TRIM
08 7108 STOPS AND HOLDERS
08 7109 ACCESSORIES

08 8000 GLAZING

08 8100 GLASS GLAZING

08 9000 LOUVERS AND VENTS

08 9120 ARCHITECTURAL FIXED LOUVERS

DIVISION 09: FINISHES

09 2000 PLASTER AND GYPSUM BOARD

09 2216 NON-STRUCTURAL METAL FRAMING
09 2900 GYPSUM BOARD

09 3000 TILING

09 3005 TILE SETTING MATERIALS AND ACCESSORIES
09 3013 CERAMIC TILING

09 5000 CEILINGS

09 5113 ACOUSTICAL PANEL CEILINGS
09 5323 METAL ACOUSTICAL SUSPENSION ASSEMBLIES

09 9000 PAINTS AND COATINGS

09 9001 COMMON PAINTING AND COATING REQUIREMENTS
09 9113 INTERIOR & EXTERIOR PAINTED METAL
09 9121 INTERIOR PAINTED CONCRETE
09 9122 INTERIOR PAINTED CMU
09 9123 INTERIOR PAINTED GYPSUM BOARD, PLASTER
09 9124 INTERIOR PAINTED METAL
09 9321 INTERIOR SEALED CONCRETE FLOORS
09 9413 INTERIOR TEXTURED FINISHING

DIVISION 10: SPECIALTIES

10 1000 INFORMATION SPECIALTIES

10 1495 MISCELLANEOUS INTERIOR SIGNAGE

10 2000 INTERIOR SPECIALTIES

10 2813 COMMERCIAL TOILET ACCESSORIES

DIVISION 11: EQUIPMENT

NO REQUIREMENTS

DIVISION 12: FURNISHINGS

NO REQUIREMENTS

DIVISION 13: SPECIAL CONSTRUCTION

NO REQUIREMENTS

DIVISION 14: CONVEYING SYSTEMS

NO REQUIREMENTS

DIVISIONS 15 THROUGH 19: NOT USED

FACILITY SERVICES SUBGROUP

DIVISION 20: NOT USED

DIVISION 21: FIRE SUPPRESSION

NO REQUIREMENTS

DIVISION 22: PLUMBING

22 0000 PLUMBING

22 0100 GENERAL REQUIREMENTS FOR PLUMBING
22 0500 BASIC MATERIAL AND METHODS FOR PLUMBING
22 0519 METERS AND GAGES FOR PLUMBING PIPING
22 0523 GENERAL-DUTY VALVES FOR BOILER ROOM PIPING
22 0548 VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
22 0553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
22 0700 PLUMBING INSULATION

22 1000 PLUMBING PIPES AND PUMPS

22 1116 DOMESTIC WATER PIPING
22 1119 DOMESTIC WATER PIPING SPECIALTIES
22 1316 SANITARY WASTE AND VENT PIPING
22 1319 SANITARY WASTE PIPING SPECIALTIES
22 1413 STORM DRAINAGE PIPING
22 1423 STORM DRAINAGE PIPING SPECIALTIES
22 1513 AIR ATOMIZATION PIPING

22 3000 PLUMBING EQUIPMENT

22 3100 WATER SOFTENERS

22 4000 PLUMBING FIXTURES

22 4000 PLUMBING FIXTURES
22 4500 EMERGENCY PLUMBING FIXTURES
22 4700 DRINKING FOUNTAINS AND WATER COOLERS

DIVISION 23: HEATING, VENTILATING, AND AIR-CONDITIONING

23 0000 HEATING, VENTILATING, AND AIR–CONDITIONING

23 0100 GENERAL REQUIREMENTS FOR MECHANICAL
23 0500 BASIC MATERIALS AND METHODS FOR MECHANICAL
23 0513 COMMON MOTOR REQUIREMENTS FOR MECHANICAL EQUIPMENT
23 0523 GENERAL-DUTY VALVES FOR MECHANICAL PIPING
23 0548 VIBRATION AND SEISMIC CONTROLS FOR MECHANICAL PIPING AND EQUIPMENT
23 0553 IDENTIFICATION FOR MECHANICAL PIPING AND EQUIPMENT
23 0593 TESTING, ADJUSTING, AND BALANCING FOR MECHANICAL
23 0700 MECHANICAL INSULATION

23 1000 FACILITY FUEL SYSTEMS

23 1113 FACILITY FUEL-OIL PIPING
23 1123 FACILITY NATURAL-GAS PIPING

23 2000 HVAC PIPING AND PUMPS

23 2113 HYDRONIC PIPING
23 2113 STEAM AND CONDENSATE HEATING PIPING
23 2300 REFRIGERANT PIPING
23 2500 BOILER AND STEAM CHEMICAL TREATMENT

23 3000 HVAC AIR DISTRIBUTION

23 3113 METAL DUCTS
23 3300 AIR DUCT ACCESSORIES
23 3713 DIFFUSERS, REGISTERS, AND GRILLES

23 5000 CENTRAL HEATING EQUIPMENT

23 5100 STACKS
23 5216 CONDENSING UNITS
23 5239 FIRE-TUBE BOILERS
23 5316 DEAERATORS
23 5400 FURNACES

DIVISION 24: NOT USED

DIVISION 25: INTEGRATED AUTOMATION

NO REQUIREMENTS

DIVISION 26: ELECTRICAL

26 0001 ELECTRICAL GENERAL PROVISIONS
26 0070 ELECTRICAL CONNECTIONS FOR EQUIPMENT
26 0072 ELECTRICAL SUPPORT & SEISMIC RESTRAINTS
26 0110 CONDUIT RACEWAYS
26 0120 CONDUCTORS & CABLES
26 0135 ELECTRICAL BOXES & FITTINGS
26 0140 WIRING DEVICES
26 0155 MOTOR STARTERS
26 0160 PANELBOARDS
26 0170 DISCONNECT SWITCHES

26 0180 OVERCURRENT PROTECTIVE DEVICES
26 0181 DRY-TYPE TRANSFORMERS
26 0182 PAD-MOUNTED TRANSFORMERS
26 0183 MOTOR CONTROL CENTERS
26 0184 POWER FACTOR CORRECTION
26 0289 TVSS SYSTEMS
26 0420 SERVICE ENTRANCE
26 0452 GROUNDING
26 0510 INTERIOR AND EXTERIOR BUILDING LIGHTING
26 0610 EMERGENCY ELECTRICAL SYSTEMS

DIVISION 27: COMMUNICATIONS

27 0740 TELEPHONE AND DATA SYSTEMS

DIVISION 28: ELECTRONIC SAFETY AND SECURITY

28 0721 DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

DIVISION 29: NOT USED

SITE AND INFRASTRUCTURE SUBGROUP

DIVISION 30: NOT USED

DIVISION 31: EARTHWORK

31 0000 EARTHWORK

31 0501 COMMON EARTHWORK REQUIREMENTS

31 1000 SITE CLEARING

31 1100 CLEARING AND GRUBBING
31 1413 TOPSOIL STRIPPING AND STOCKPILING

31 2000 EARTH MOVING

31 2213 ROUGH GRADING
31 2216 FINE GRADING
31 2316 EXCAVATION
31 2323 FILL
31 2324 GRANULAR BASE
31 2500 EROSION & SEDIMENTATION CONTROLS

31 4000 SHORING AND UNDERPINNING

DIVISION 32: EXTERIOR IMPROVEMENTS

32 1000 BASES, BALLASTS, AND PAVING

32 1216 ASPHALT PAVING

32 3000 SITE IMPROVEMENTS

32 3213 CAST-IN-PLACE CONCRETE RETAINING WALLS

32 8000 I R R I G A T I O N

32 8423 UNDERGROUND SPRINKLERS

32 9000 P L A N T I N G

32 9001 COMMON PLANTING REQUIREMENTS
32 9113 SOIL PREPARATION
32 9120 TOPSOIL PLACEMENT AND GRADING
32 9222 HYDRO-SEEDING
32 9300 PLANTS
32 9413 LANDSCAPE EDGING

D I V I S I O N 33: U T I L I T I E S

33 1000 W A T E R U T I L I T IE S

33 1116 SITE WATER UTILITY DISTRIBUTION PIPING : COPPER

33 3000 S A N I T A R Y S E W E R E A G E U T I L I T I ES

33 3313 SANITARY UTILITY SEWERAGE

33 4000 S T O R M D R A I N A G E U T I L I T I E S

33 4116 SITE STORM UTILITY DRAINAGE PIPING

D I V I S I O N S 36 THROUGH 39: NOT USED

PROCESS EQUIPMENT SUBGROUP

D I V I S I O N S 40 THROUGH 49: NOT USED

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DIVISION 01 - GENERAL REQUIREMENTS

01100 SUMMARY

01300 ADMINISTRATIVE REQUIREMENTS

01400 QUALITY REQUIREMENTS

01500 TEMPORARY FACILITIES & CONTROLS

01600 PRODUCT REQUIREMENTS

01700 EXECUTION REQUIREMENTS

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SECTION 01 1100

SUMMARY

PART 1 GENERAL

1.1 SCOPE OF DIVISION 01

A. Provisions contained in Division 01 apply to Sections of Divisions 02 through 16 of Specifications. Instructions contained in Specifications are directed to Contractor. Unless specifically provided otherwise, obligations set forth in Contract Documents are obligations of Contractor.

B. The Owner's General and Supplemental Conditions supercede the requirements of this section, if more stringent.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Contractor will furnish total labor, materials, equipment, and services necessary to perform The Work in accordance with Contract Documents.

1.3 WORK UNDER SEPARATE CONTRACTS

A. Separate contracts may be issued for performance of certain construction operations at site. Schedule these operations to be completed during construction operations performed under this Contract.
   1. Demolition of the existing boiler plant building.

B. For items specified above, Contractor will:
   1. Allow Owner sufficient lead time for orderly procurement.
   2. Schedule delivery of items and performance of work covered by such separate contracts in Contractor's Construction Schedule so as to avoid delays in Substantial Completion. Give written notice to vendors, contractors, and Owner of any revisions to scheduled delivery and work dates at least 90 days in advance.
   3. Complete work necessary to receive items provided under such separate contracts prior to scheduled date for performance of such items. Contractor will be back charged for actual expenses incurred by Owner for failure to timely complete such work, including but not limited to cost of crews during downtime or for call backs and costs to correct substrate deficiencies.
   4. Store and protect completed work until date of Substantial Completion.

C. Owner has issued or will issue separate contracts for following operations scheduled to precede and be substantially completed before beginning of The Work under this Contract
   1. Commercial kitchen equipment
   2.

D. Owner has issued or will issue separate contracts for following operations scheduled to follow Substantial Completion.
   1. Furnish and install Furniture & Accessories
   2. Furnish and install telephone sets and terminate building cables at terminal board

1.4 WORK RESTRICTIONS

A. During construction period, Contractor will have limited use of premises for construction operations. Contractor will ensure that Contractor, its employees, subcontractors and employees comply with following requirements.

1. Confine operations to areas not occupied by the Owner. Coordinate with Owner for phasing of work in existing portions of the building.
2. Do not allow alcoholic beverages, illegal drugs, or persons under their influence on Project site.
3. Do not allow use of tobacco in any form on Project Site.
4. Do not build fires on Project Site.
5. Reasonably accommodate use of existing facilities by Owner.
6. Do not allow weapons on Project Site, except those carried by law enforcement officers or other uniformed security personnel who have been retained by Owner or Contractor to provide security services.
7. Do not load or permit any part of the structure to be loaded with a weight which will endanger its safety. Questions of structural loading as part of construction means and methods shall be addressed by a licensed structural engineer engaged by Contractor, subject to the review by Architect.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 1300

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Includes But Not Limited To
   1. Administrative and supervisory requirements necessary for Project coordination.
   2. Administrative and procedural requirements for Project meetings.
   3. Administrative and procedural requirements for submittals required for performance of the Work.

B. Related Sections
   1. Refer to other Division 01 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to -
      a. Permits.
      b. Applications for payment.
      c. Performance and payment bonds.
      d. Insurance certificates.
      e. List of Subcontractors.
   2. Section 01200, Price & Payment Procedures - Schedule of Values submittal
   3. Section 01400, Quality Controls - Inspection and test reports
   4. Section 01700, Contract Closeout - Closeout submittals.

C. The Owner's General and Supplemental Conditions supercede the requirements of this section, if more stringent.

1.2 PROJECT MANAGEMENT & COORDINATION

A. General - Not Used

B. Project Coordination
   1. Coordinate construction activities included in Contract Documents to assure efficient and orderly installation of each part of the Work. Coordinate construction operations that are dependent upon each other for proper installation, connection, and operation.
      a. Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in sequence required to obtain best results.
      b. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
      c. Make adequate provisions to accommodate items scheduled for later installation.
   2. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings. Prepare similar memoranda for Owner and separate Contractors where coordination of their Work is required.
   3. Administrative Procedures -
      a. Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to -
         1) Preparing of schedules.

2) Installing and removing temporary facilities.
3) Delivering and processing submittals.
4) Progress meetings.
5) Pre-installation meetings.
6) Project close-out activities.

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

C. Project Meetings

1. Preconstruction Conference -
   a. Architect will schedule preconstruction conference and organizational meeting at Project site or other convenient location by 15 days after issuance of Notice To Proceed and before commencement of construction activities. Architect will conduct meeting to review responsibilities and personnel assignments.
   b. Attenders - Owner, Architect, and their consultants, Contractor and his superintendent, major Subcontractors and other concerned parties shall each be represented at conference by persons familiar with and authorized to conclude matters relating to the Work.
   c. Agenda - Discuss items of significance that could affect progress including such topics as
      1) Tentative construction schedule.
      2) Critical Work sequencing.
      3) Designation of responsible personnel.
      4) Procedures for processing interpretations and Modifications.
      5) Procedures for processing Payment Requests.
      6) Distribution of Contract Documents.
      7) Submittal of Product Data, Shop Drawings, Samples, Quality Assurance/ Control submittals.
      8) Preparation of record documents and O & M manual.
      9) Use of the premises.
      10) Office, work, and storage areas.
      11) Equipment deliveries and priorities.
      12) Safety procedures.
      13) First aid.
      14) Security.
      15) Housekeeping.
      16) Working hours.
      17) Resolving current problems.
      18) Further orientation as to requirements of Contract Documents.
      19) Architect's responsibility to Owner for inspection.
      20) Working out general schedule of Architect's inspection.
   d. Architect will record significant discussions and agreements and disagreements of each meeting and distribute minutes of meeting to everyone concerned, including Owner, within three working days.
2. Progress Meetings -
   a. Contractor will conduct progress meetings at Project site at regularly scheduled intervals.
   b. Owner, Architect, Contractor, and each Subcontractor concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings by persons familiar with Project and authorized to conclude matters relating to progress.
   c. Agenda -
      1) 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.
      2) Review progress since last meeting. Determine where each activity is

in relation to Contractor's Construction Schedule, whether on time or ahead or behind schedule. Decide how construction behind schedule is to be expedited and secure commitments from parties involved bring construction back into conformance with schedule. Discuss schedule revisions required to ensure that current and subsequent activities will be completed within Contract Time.

3) Discuss present and future needs of each entity present, including such items as -
   a) Interface requirements.
   b) Time.
   c) Sequences.
   d) Deliveries.
   e) Off-site fabrication problems.
   f) Access.
   g) Site use.
   h) Temporary facilities and services.
   i) Hours of work.
   j) Hazards and risks.
   k) Housekeeping.
   l) Quality and Work standards.
   m) Modifications.
   n) Documentation of information for Payment Requests.

d. Contractor will include brief summary, in narrative form, of progress since previous meeting. By three days after each progress meeting date, Architect will distribute copies of meeting minutes to each party present and to parties who should have been present, including Owner.

c. Revise Contractor's Construction Schedule after each progress meeting where revisions to schedule have been made or recognized. Issue revised schedule by three days after each progress meeting date, to each party present and to parties who should have been present, including Owner.

3. Pre-installation Meetings -

a. Contractor will schedule these meetings to occur at same time as Contractor's regularly scheduled inspection visits, if possible. Hold pre-installation meetings at site before commencement of work specified in trade Sections specifying such a meeting.

b. Attenders - Architect, Contractor, applicable Subcontractors, item or system suppliers/installers, Manufacturer's representatives, and others as specified or invited. Contractor will conduct meeting.

1) Review progress of other construction activities and preparations for particular activity under consideration at each pre-installation meeting, including -
   a) Reviewing and confirming requirements of Contract Documents including related Modifications.
   b) Verifying that completed work is ready for installation of items or systems.
   c) Resolving conditions not in compliance with installation requirements.
   d) Establishing installation and inspection schedule.
   e) Coordination between trades.
   f) Work of other trades which affect work of trade Section.
   g) Other items specified in individual Sections.
   h) Deliveries.
   i) Shop Drawing, Product Data, Sample, and Quality Assurance/ Control submittals.
   j) Possible conflicts.

k) Compatibility problems.
l) Weather limitations.
m) Manufacturer's recommendations.
n) Temporary facilities.
o) Space and access limitations.
p) Governing regulations.
q) Safety.
r) Testing requirements.
s) Required performance results.
t) Recording requirements.
u) Protection.

2) Contractor will record significant discussions and agreements and disagreements of each meeting, and distribute minutes of meeting within three working days to everyone concerned, including Owner.

3) Make adjustments to work schedule necessitated by decisions of meeting. Do not proceed with work of Section involved if meeting cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene meeting within one week.

1.3 CONSTRUCTION PROGRESS DOCUMENTATION

A. Contractor's Construction Schedule

1. Prepare fully developed, horizontal bar chart type Contractor's Construction Schedule. Submit within 30 days of date established for 'Commencement of the Work.'
   a. Provide separate time bar for each significant construction activity. Provide continuous vertical line to identify first working day of each week. Use same breakdown of units of the Work as shown in Schedule of Values.
   b. Within each time bar show estimated completion percentage in 10 percent increments. As Work progresses, place contrasting mark in each bar to indicate actual completion.
   c. Prepare schedule on sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for entire construction period.
   d. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on schedule with other construction activities, including minor elements involved in sequence of the Work. Show each activity in proper sequence. Show graphically sequences necessary for completion of related portions of the Work.
   e. Coordinate Contractor's Construction Schedule with Schedule of Values, list of subcontracts, submittal schedule, progress reports, payment requests, and other schedules.
   f. Show completion before date established for Substantial Completion. Show Substantial Completion on schedule to allow time for Architect's procedures necessary for certification of Substantial Completion.
2. Show important stages of construction for each major portion of the Work, including testing and installation.
3. Provide separate time bar to identify each major construction area for each major portion of the Work. Show where each element in an area must be sequenced or integrated with other activities.
4. Revise schedule after each meeting or activity where revisions have been recognized or made. Issue updated schedule concurrently with report of each meeting.
   5. Acceleration Of The Work -
   a. If circumstances require that the Work or portion thereof be completed at date

earlier than Contract completion date as adjusted by Modifications and if directed by Architect or Owner, increase forces, equipment, hours of work, and/or number of shifts and speed up delivery of materials to meet altered completion date or dates ordered or directed. Any increase in cost to Contractor in compliance with such orders or directives will be reflected in an adjustment in Contract Sum in accordance with additional work performed.

b. If in judgment of Architect or Owner the Work is behind schedule and rate of placement of work is inadequate to regain scheduled progress and if so informed by Architect or Owner, immediately take action to increase rate of work placement.
   1) This shall be accomplished by any one or a combination of the following or other suitable measures -
      a) An increase in working forces,
      b) An increase in equipment or tools,
      c) An increase in hours of work or number of shifts,
      d) Speeding up delivery of materials.
   2) Within 10 days after being so informed, notify Architect of specific measures taken and/or planned to increase rate of progress with an estimate of when scheduled progress will be regained. If plan of action is deemed inadequate by Architect or Owner, take additional steps or make adjustments to plan of action until it meets with Architect's or Owner's approval.
   3) Acceleration of work will continue until scheduled progress is regained. Establish scheduled progress from latest revised approved progress schedule for Project. Timely completion is understood to be contract completion date as revised by time extensions granted at time acceleration is undertaken.
   4) No additional compensation for additional effort applied to the Work under terms of this subparagraph will be granted.

c. Any directive or order to accelerate the Work will be in writing. Any directive or order terminating accelerated work will be in writing.

1.4 SUBMITTAL PROCEDURES

A. General
   1. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently before performance of related construction activities to avoid delay.
      a. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
      b. Coordinate transmittal of different types of submittals required for related elements of the Work so processing will not be delayed by need to review submittals concurrently for coordination. Architect reserves right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
      c. Allow sufficient review time so installation will not be delayed by time required to process submittals, including time for resubmittals.
         1) Allow7 days for initial review. Allow additional time if processing must be delayed to allow coordination with subsequent submittals. Architect will promptly advise Contractor when submittal being processed must be delayed for coordination.
         2) If an intermediate submittal is necessary, process same as initial submittal.
         3) Allow 5 days for reprocessing each submittal.

4) No extension of Contract Time will be authorized because of failure to transmit submittals to Architect in sufficient time before work is to be performed to allow processing.

2. Place permanent label or title block on each submittal for identification. Include name of entity that prepared each submittal on label or title block.
   a. Provide space approximately 4 by 5 inches on label or beside title block on Shop Drawings to record Contractor's review and approval markings and action taken.
   b. Include following information on label for processing and recording action taken.
      1) Project name.
      2) Date.
      3) Name and address of Architect.
      4) Name and address of Contractor.
      5) Name and address of Subcontractor.
      6) Name and address of supplier.
      7) Name of manufacturer.
      8) Number and title of appropriate Specification Section.
      9) Drawing number and detail references, as appropriate.
3. Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using transmittal letter. On transmittal, record relevant information and requests for data. Include Contractor's certification that information complies with Contract Document requirements, or, on form or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations.
4. Submittals received from sources other than Contractor or not marked with Contractor's approval will be returned without action.

C. Product Data
1. Collect Product Data, as required by individual Sections, into separate submittals. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as Shop Drawing.
2. Mark each copy to show choices and options used on Project. Where printed Product Data includes information on products which are not required for Project, mark copies to indicate information relating to Project.
3. Do not submit Product Data until compliance with requirements of Contract Documents has been confirmed.
4. Submit preliminary single copy of Product Data where selection of options by Architect is required.
5. Submit five copies minimum of each required submittal. Architect will retain two and return others marked with action taken and with corrections or modifications required. Unless noncompliance with Contract Document provisions is observed, submittal may serve as final submittal. Insert one marked copy in Owner-provided three-ring binders used to become Operations & Maintenance Manuals specified in Section 01700.
6. Furnish copies of final submittal to Subcontractors and others as required for performance of construction activities. Show distribution on transmittal forms.
   a. Do not proceed with installation until applicable copy of Product Data is in installer's possession.
   b. Do not allow use of unmarked copies of Product Data in connection with construction.

D. Shop Drawings
1. Submit newly prepared graphic data to accurate scale. 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 36 by 48 inches. Highlight, encircle, or otherwise show deviations from Contract Documents. Include following information as a minimum -

a. Dimensions.
b. Identification of products and materials included.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.

2. Do not reproduce Contract Documents or copy standard information as basis of Shop Drawings. Standard printed information prepared without specific reference to Project is not acceptable as Shop Drawings.
3. Review and designate (stamp) approval of shop drawings. Submit to Architect, with reasonable promptness and in orderly sequence, shop drawings required by Contract Documents. Shop drawings not required by Contract Documents, but requested by Contractor or supplied by Subcontractor need not be submitted to Architect for review. However, these shop drawings shall meet specified shop drawing requirements except those relating to submission to Architect.
   a. Bear cost of reproducing copies of shop drawings required by all concerned. Instead of prints, a sepia may be required.
   b. Shop drawings shall be complete and detailed.
   c. Shop drawings shall be properly identified as specified or as Architect may require.
   d. Provide 6 copies of shop drawings unless required otherwise in specification Section.

E. Samples

1. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
   a. Mount, display, or package Samples so as to ease review of qualities indicated. Prepare Samples to match samples provided by Architect, if applicable. Include following -
      1) Generic description of Sample.
      2) Sample source.
      3) Product name or name of manufacturer.
      4) Compliance with recognized standards.
      5) Availability and delivery time.
   b. Submit Samples for review of kind, color, pattern, and texture, for 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.
      1) Where variations in color, pattern, texture or other characteristics are inherent in material or product represented, submit multiple units (not less than 3), which show approximate limits of variations.
      2) Refer to other specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.
      3) Refer to other Sections for Samples to be returned to Contractor for incorporation in the Work. Such Samples must be undamaged at time of use. On transmittal, indicate special requests regarding disposition of Sample submittals.
   c. Where Samples are for selection of color, pattern, texture, or similar characteristics from a range of standard choices, submit full set of choices for material or product. Preliminary submittals will be reviewed and returned with

Architect's mark indicating selection and other action.

d. Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation, and similar characteristics, submit 3 sets. One will be returned marked with action taken.

e. Samples, as accepted and returned by Architect, shall be used for quality comparisons throughout course of construction.

1) Unless noncompliance with Contract Documents is observed, submittal may serve as final submittal.

2) Sample sets may be used to obtain final acceptance of construction associated with each set.

2. Prepare and distribute additional sets to Subcontractors and others as required for performance of the Work. Show distribution on transmittal forms.

F. Quality Assurance/Control - Quality Assurance/Control submittals are design data, test reports, certificates, manufacturer's instructions, manufacturer's field reports, and other documentary data affirming quality of products and installations. Submit 2 copies to Architect immediately upon receipt.

G. Architect's Action

1. Allow 7 days for Architect's review and return for initial submittals and 5 days for re-submittals.

2. Submittals reviewed by Architect will be identified as having received such review by being so stamped and dated.

a. Where submittals are marked 'Approved,' that part of the Work covered by submittal may proceed provided it complies with requirements of Contract Documents. Final acceptance will depend upon that compliance.

b. When submittals are marked 'Approved as Noted,' that part of the Work covered by submittal may proceed provided it complies with notations or corrections on submittal and requirements of Contract Documents. Final acceptance will depend on that compliance.

c. When submittal is marked 'Not Approved, Revise and Resubmit,' do not proceed with that part of the Work covered by submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare new submittal according to notations and resubmit without delay at no additional cost to Owner. Repeat as necessary to obtain satisfactory action mark. Do not allow submittals marked 'Not Approved, Revise and Resubmit' to be used at Project site, or elsewhere where the Work is in progress.

d. Where submittal is primarily for information or record purposes, special processing, or other activity, submittal will be returned, marked 'Action Not Required.'

3. Two copies of each submittal will be retained in Architect's office until completion of Project.

4. Except for submittals for record, information, or similar purposes, where action and return are required or requested, Architect will review each submittal, mark to show action taken, and return promptly to Contractor.

1.5 SPECIAL PROCEDURES - NOT USED

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 1400

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Includes But Not Limited To
   1. Administrative and procedural requirements for relating to quality.

B. The Owner's General and Supplemental Conditions supercede the requirements of this section, if more stringent.

1.2 REGULATORY REQUIREMENTS

A. Permits, Fees, & Improvement Bonds
   1. Contractor is responsible to obtain all required permits and pay all related fees.
   2. A building permit with the local municipality is not required for the new building.

B. Asbestos
   1. Contract Documents for this Project have been prepared in accordance with generally accepted professional architectural and engineering practices. Accordingly, no asbestos or products containing asbestos have been knowingly specified for this Project. Notify Architect immediately for instructions if -
      a. Materials containing asbestos are brought to site for inclusion in the Work.
   2. At Architect's direction and with Owner's approval, an independent testing laboratory will perform testing procedures on suspect materials.
   3. Certify that based upon best knowledge, information, inspection, and belief no building materials containing asbestos were used in construction of Project. Submit certification on form provided by Owner.

1.3 REFERENCES

A. Owner Standards
   1. All work shall comply with the DFCM Standards, which are available on their web-site – http://dfcm.utah.gov.

B. Reference Standards

   1. Industry Standards -
      a. Except where Contract Documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into Contract Documents to extent referenced. Such standards are made a part of Contract Documents by reference.
      b. Comply with standard in effect as of date of Contract Documents, unless specific date is specified.
      c. Where compliance with two or more standards is specified and standards apparently establish different or conflicting requirements for minimum quantities or quality levels, refer to Architect for decision before proceeding. Quantity or quality level shown or specified shall be minimum provided or performed. Actual installation may comply exactly with minimum quantity or quality specified, or it may exceed minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for context of requirements. Refer uncertainties to Architect for decision before proceeding.
      d. Each entity engaged in construction on Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with Contract Documents. Where copies

of standards are needed for performance of a required construction activity, Contractor shall obtain copies directly from publication source.

e. Trade association names and titles of general standards are frequently abbreviated. Following acronyms or abbreviations, as referenced in Contract Documents, are defined to mean associated names. Names and addresses are subject to change and are believed to be, but are not assured to be, accurate and up to date as of date of Contract Documents.

AABC Associated Air Balance Council, 1518 K St NW, Suite 503, Washington, D.C. 20005 (202) 737-0202

AAMA American Architectural Manufacturers Assoc, 1540 K Street NW, Palatine, IL 60067 (708) 202-1350

AAN American Association of Nurserymen, 1250 Eye St NW, Suite 500, Washington, D.C. 20005 (202) 789-290

ACI American Concrete Institute, P.O. Box 19150, 22400 West 7 Mile Rd, Detroit, MI 48219 (313) 532-2600

AGA American Gas Assoc, 1515 Wilson Blvd, Arlington, VA 22209 (703) 841-8400

AIA American Institute of Architects, 1735 New York Ave NW, Washington, D.C. 20006 (202) 626-7300

AISC American Institute of Steel Construction, One East Wacker Drive, Suite 3100, Chicago, IL 60601-2001 (312) 670-2400

AMCA Air Movement & Control Assoc, 30 West University Dr, Arlington Heights, IL 60004 (312) 394-0150

ANSI American National Standards Institute, 11 West 42nd St, New York, NY 10036 (212) 642-4900

APA American Plywood Assoc, P.O. Box 11700 (98411), 7011 South 19th St (98466), Tacoma, WA (206) 565-6600

ARI Air Conditioning & Refrigeration Institute, 4301 Fairfax Drive, Suite 425, Arlington, VA 22203 (703) 524-8800

ASHRAE American Society of Heating, Refrigerating, & Air-Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, GA 30329 (404) 636-8400

ASME American Society of Mechanical Engineers, 345 East 47th St, New York, NY 10017 (212) 705-7722

ASTM American Society for Testing & Materials, 1916 Race St, Philadelphia, PA 19103 (215) 299-5400

AWI Architectural Woodwork Institute, 13924 Braddock Road, Suite 100, P O Box 1550, Centreville, VA 22020 (703) 222-1100

AWS American Welding Society, 550 LeJeune Road NW, P.O. Box 351040, Miami, FL 33135 (305) 443-9353

BHMA Builders' Hardware Manufacturers Assoc, 355 Lexington Ave, 17th Floor, New York, NY 10017 (212) 661-4261

CFI International Certified Floorcovering Installers Assoc, 10336 NW Prairie View Rd, Kansas City, MO 64153 (816) 880-9999

CRI Carpet & Rug Institute, P O Box 2048, Dalton, GA 30722 (706) 278-3176

CRSI Concrete Reinforcing Steel Institute, 933 Plum Grove Rd, Schaumburg, IL 60173 (312) 517-1200

DHI Door & Hardware Institute, 14170 Newbrook Drive, Chantilly, VA 22021 (703) 222-2010

FM Factory Mutual Research Organization, 1151 Boston-Providence Turnpike, Norwood, MA 02062 (617) 762-4300

GA Gypsum Association, 810 First Street NE, Suite 510, Washington, D.C. 20002 (202) 289-5440

ICBO International Conference of Building Officials, 5360 S. Workman Mill Rd, Whittier, CA (310) 699-0541

NAAMM National Association of Architectural Metal Manufacturers, 600 South Federal St, Suite 400, Chicago, IL 60605 (312) 922-6222

NEC	National Electric Code (from NFPA)
NEMA	National Electrical Manufacturer's Association, 2101 'L' St, NW, Washington, D.C. 20037 (202) 457-8400
NFRC	National Fenestration Rating Council, 1300 Spring Street, Suite 120, Silver Spring, MD 20910 (301) 589-6372
NSF	National Sanitation Foundation, 3475 Plymouth Rd, P.O. Box 1468, Ann Arbor, MI 48106 (313) 769-8010
PCA	Portland Cement Assoc, 5420 Old Orchard Road, Skokie, IL 60077 (312) 966-6200
PCI	Prestressed Concrete Institute, 175 West Jackson Blvd, Chicago, IL 60604 (312) 786-0300
PEI	Porcelain Enamel Institute, 102 Woodmont Boulevard, Suite 360, Nashville, TN 38205 (615) 385-0758
SDI	Steel Door Institute, 30200 Detroit Road, Cleveland, OH 44145 (216) 899-0010
SIGMA	Sealed Insulating Glass Manufacturers Association, 401 North Michigan Avenue, Chicago, IL 60611 (312) 644-6610
SJI	Steel Joist Institute, 1205 48th Avenue North, Suite A, Myrtle Beach, SC 29577 (803) 449-0487
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, 4201 Lafayette Center Drive, Chantilly, VA 22116 (703) 803-2980
TCA	Tile Council of America, P.O. Box 326, Princeton, NJ 08542 (609) 921-7050
TPI	Truss Plate Institute, 583 D'Onofrio Drive, Suite 200, Madison, WI 53719 (608) 833-5900
UL	Underwriters Laboratories, 333 Pfingsten Rd, Northbrook, IL 60062 (708) 272-8800
WWPA	Western Wood Products Assoc, Yeon Building 522 SW 5th Avenue, Portland, OR 97204-2122 (503) 224-3930

2. Federal Government Agencies - Names and titles of federal government standard or specification producing agencies are often abbreviated. Following acronyms or abbreviations referenced in Contract Documents represent names of standard or specification producing agencies of federal government. Names and addresses are subject to change but are believed to be, but are not assured to be, accurate and up to date as of date of Contract Documents.

CS	Commercial Standard (U.S. Department of Commerce), Government Printing Office, Washington, D.C. 20402 (202) 377-2000
EPA	Environmental Protection Agency, 401 'M' St SW, Washington, D.C. 20460 (202) 382-2090
FCC	Federal Communications Commission, 1919 'M' St NW, Washington, D.C. 20554 (202) 632-7000
FS	Federal Specification (from GSA), Specifications Unit (WFSIS), 7th & D St SW, Washington, D.C. 20406 (202) 708-9205
MIL	Military Standardization Documents (U.S. Department of Defense), Naval Publications & Forms Center, 5801 Tabor Ave, Philadelphia, PA 19120
OSHA	Occupational Safety & Health Administration (U.S. Department of Labor), 200 Constitution Ave NW, Washington, D.C. 20410 (202) 219-6091
PS	Product Standard of NBS (U.S. Department of Commerce), Government Printing Office, Washington, D.C. 20402 (202) 783-3238

B. Governing Regulations/Authorities

1. Architect has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents. Contact authorities having jurisdiction directly for information and decisions having a bearing on the

Work.

2. Obtain copies of regulations required to be retained at Project Site, available for reference by parties who have a reasonable need for such reference.

C. Submittals - For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records establishing compliance with standards and regulations bearing upon performance of the Work.

1.4 QUALITY CONTROL

A. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and Contractor. They do not include Contract enforcement activities performed by Architect.

B. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Documents.

C. Requirements of this paragraph relate to customized fabrication and installation procedures, not production of standard products.

1. Specific quality control requirements for individual construction activities are specified in Sections that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures.
2. Inspections, tests, and related actions specified are not intended to limit Contractor's quality control procedures that ease compliance with Contract Documents.
3. Requirements for Contractor to provide quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

D. Field Samples specified in individual Sections are special types of Samples. Field Samples are full-size examples built on site to illustrate finishes, coatings, or finish materials and to establish standard by which the Work will be judged. Comply with submittal requirements to fullest extent possible. Process transmittal forms to provide record of activity.

E. Contractor Responsibilities

1. Provide inspections, tests, and similar quality control services specified in individual specification Sections and required by governing authorities, except where they are specifically shown to be Owner's responsibility or to be provided by another identified entity. These services include those specified to be performed by an independent agency and not by Contractor. Include costs for these services in Contract Sum.
2. Employ and pay an independent agency, to perform specified quality control services.
3. Retest where results of required inspections, tests, or similar services prove unsatisfactory and do not show compliance with Contract Document requirements, no matter whether original test was Contractor's responsibility. Cost of retesting construction revised or replaced by Contractor is Contractor's responsibility, where required tests were performed on original construction.
4. Cooperate with agencies performing required inspections, tests, and similar services and provide reasonable auxiliary services as requested. Notify agency sufficiently before operations to allow assignment of personnel. Auxiliary services required include but are not limited to -
   a. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
   b. Taking adequate quantities of representative samples of materials that require testing or helping agency in taking samples.

c. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
d. Providing agency with preliminary design mix proposed for use for materials mixes that require control by testing agency.
e. Security and protection of samples and test equipment at Project site.

F. Owner Responsibilities
1. Owner will provide inspections, tests, and similar quality control services specified to be performed by independent agencies and not by Contractor, except where they are specifically indicated as Contractor's responsibility or are provided by another identified entity. Costs for these services shall not be included in Contract Sum.
2. Owner will employ and pay for services of an independent agency, testing laboratory, or other qualified firm to perform services which are Owner's responsibility.

G. Testing Laboratory Services
1. Engage inspection and testing service agencies, including independent testing laboratories, only with written approval of Architect. Each independent inspection and testing agency engaged on Project shall be authorized by authorities having jurisdiction to operate in State in which Project is located.
2. Duties of Testing Agency
a. Independent testing agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual specification Sections shall cooperate with Architect and Contractor in performance of its duties and shall provide qualified personnel to perform required inspections and tests.
b. Agency shall notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
c. Agency is not authorized to release, revoke, alter, or enlarge requirements of Contract Documents, or approve or accept any portion of the Work.
d. Agency shall not perform any duties of Contractor.
3. Submittals -
a. Independent testing agency shall submit certified written report of each inspection, test, or similar service, to Architect, and Engineer, in duplicate, unless Contractor is responsible for service. If Contractor is responsible for service, submit certified written report of each inspection, test, or similar service through Contractor, in duplicate.
1) Submit additional copies of each written report directly to governing authority, when authority so directs.
2) Written reports of each inspection, test, or similar service shall include, but not be limited to -
a) Date of issue.
b) Project title and number.
c) Name, address and telephone number of testing agency.
d) Dates and locations of samples and tests or inspections.
e) Names of individuals making the inspection or test.
f) Designation of the Work and test method.
g) Identification of product and specification Section.
h) Complete inspection or test data.
i) Test results and interpretations of test results.
j) Ambient conditions at time of sample-taking and testing.
k) Comments or professional opinion as to whether inspected or tested Work complies with Contract Document requirements.
l) Name and signature of laboratory inspector.
m) Recommendations on retesting.

H. Contractor and each agency engaged to do inspections, tests, and similar services shall coordinate sequence of activities to accommodate required services with minimum of

delay. In addition, Contractor and each agency shall coordinate activities to avoid necessity of removing and replacing construction to accommodate inspections and tests. Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 REPAIR & PROTECTION

A. Upon completion of inspection, testing, sample-taking, and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with Contract Documents for new work.

B. Protect construction exposed by or for quality control service activities, and protect repaired construction.

C. Repair and protection is Contractor's responsibility, regardless of assignment of responsibility for inspection, testing, or similar services.

END OF SECTION

SECTION 01 1500

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install temporary utilities, temporary construction and support facilities, and security and protection facilities as described in Contract Documents.

B. The Owner's General and Supplemental Conditions supercede the requirements of this section, if more stringent.

1.2 QUALITY ASSURANCE

A. Comply with industry standards and applicable laws and regulations of authorities having jurisdiction.

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

1.3 PROJECT CONDITIONS

A. Prepare schedule indicating dates for implementation and termination of each temporary utility. At earliest feasible time and when acceptable to Owner, change over from use of temporary service to use of permanent service.

B. Keep temporary services and facilities clean and neat in appearance. Operate in safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or allow them to interfere with progress. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on Project site.

C. Limit availability of temporary facilities to essential and intended uses to reduce waste and abuse.

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

E. Remove each temporary facility when need has ended, or when replaced by authorized use of permanent facility, or by Substantial Completion. Complete permanent construction that may have been delayed because of interference with temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that make up temporary facilities are property of Contractor.
   2. By Substantial Completion, clean and renovate permanent facilities used during construction period, including but not limited to -
      a. Replace air filters and clean inside of ductwork and housings.
      b. Replace significantly worn parts and parts subjected to unusual operating conditions.
      c. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 GENERAL

A. Use qualified personnel for installation and maintenance of temporary facilities. Locate facilities where they will serve Project adequately and result in minimum interference with the Work of Owner or other Contractors on Project Site. Relocate and modify facilities as required.

B. Pay cost and use charges for temporary facilities and utilities.

3.2 TEMPORARY UTILITIES

A. General:
   1. Where necessary, engage appropriate local utility companies to install temporary service or connect to existing service. Where utility company provides only part of service, provide remainder with matching, compatible materials and equipment. Comply with utility company's recommendations.
      a. Arrange with utility company and existing users for time when service can be interrupted, where necessary, to make connections for temporary services.
      b. Provide adequate capacity at each stage of construction. Before temporary utility availability, provide trucked-in services.
      c. Obtain construction easements necessary to bring temporary and/or permanent utilities to site.

B. Temporary Electric Power: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period.

C. Temporary Fire Protection:
   1. Install and maintain temporary fire protection facilities of types needed to protect against predictable and controllable fire losses. At a minimum, provide and maintain in working order two Standard UL Labeled ABC all purpose 10 lb fire extinguishers. Do not incorporate these extinguishers into final Project.
   2. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
   3. Store combustible materials in containers in fire-safe locations.
   4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for fighting fires.
   5. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.
   6. At earliest feasible date in each area of Project, complete installation of permanent fire protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

D. Heating, Cooling, And Ventilating:
   1. Install and operate temporary heating, cooling, and ventilating units including fuel, temporary piping, fittings, wiring, and connections necessary to provide environmental conditions specified for various portions of the Work. Coordinate ventilation requirements to produce ambient conditions required and reduce consumption of energy.
   2. Repair damage to building and contents caused by cold, heat, dampness, and/or heating, cooling, and ventilating equipment. Select equipment that will not have harmful effect on completed installations or on elements being installed.
   3. Maintain safe conditions for use of temporary heating, cooling, and ventilating systems including, but not limited to, following requirements:
      a. Operate equipment according to equipment manufacturer's instructions.

b. Provide fresh air ventilation required by equipment manufacturer.
c. Keep temperature of fuel containers stabilized.
d. Secure fuel containers from overturning.
e. Operate equipment away from combustible materials.

4. Permanent mechanical system may be operated subject to the following conditions:
   a. Do not operate system when work causing air-borne dust is occurring or when dust caused by such work is present without installation of temporary filtering system approved by Architect.
   b. Operate system at no cost to Owner, including cost of fuel.
   c. Assume all responsibility and risk for operation of system.
   d. Return permanent mechanical equipment to 'like-new' condition for Substantial Completion Inspection.

E. Temporary Lighting: Install and operate temporary lighting that will provide adequate illumination for construction operations and traffic conditions.

F. Temporary Telephones:
   1. Provide temporary telephone service for all personnel engaged in construction activities, throughout construction period.
   2. Provide temporary FAX service throughout construction period.
   3. Subcontractors shall provide and maintain cellular phone service at their own expense.

G. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.

3.3 CONSTRUCTION FACILITIES

A. General: Maintain construction facilities until Substantial Completion. Remove upon Substantial Completion.

B. Field Offices:
   1. Provide and maintain insulated, weather tight temporary office of sufficient size to accommodate Contractor's personnel at Project site and for use by Owner, Architect and Subcontractors.
   2. Keep office clean and orderly.
   3. Heat and cool office as needed.
   4. Furnish office with locking door, light(s), table(s), bench(es), rack(s) for drawings, telephone, and FAX machine.
   5. Make office available for progress meetings.
   6. If Owner agrees to permit removal of temporary office before Substantial Completion, Contractor may use a room as an office after temporary office is removed. Equip room as specified above and restore to 'like-new' condition before Substantial Completion.

C. Sanitary Facilities:
   1. Provide temporary sanitary toilet.
   2. Service and maintain temporary toilet in a clean, sanitary condition.
   3. New toilets are not to be used by construction personnel under any circumstances.

3.4 CONSTRUCTION AIDS

A. Scaffolding, Platforms, Stairs, Etc:
   1. Furnish and maintain equipment such as temporary stairs, ladders, ramps, platforms, scaffolds, hoists, runways, derricks, chutes and elevators as required for proper execution of The Work.
   2. Apparatus, equipment, and construction will meet requirements of applicable laws and safety regulations.

3.5 TEMPORARY BARRIERS AND ENCLOSURES

A. Barricades, Warning Signs, And Lights:
   1. Comply with standards and code requirements in erecting barricades, warning signs, and lights.
   2. Take necessary precautions to protect persons, including members of the public, from injury or harm.

B. Enclosure Fence: Before construction begins, install 6 foot high enclosure fence with lockable entrance gates. If not shown on Drawings, enclose entire site or portion sufficient to accommodate construction operations, and allow Owner access to existing building and site as required for daily operation.

C. Security Measures:
   1. Install temporary enclosures of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and other violations of security.
   2. Secure materials and equipment stored on site.
   3. Maintain exterior building security until Substantial Completion
   4. Secure building at the end of each work day.

D. Existing Tree And Plant Protection:
   1. Before commencing site work, build and maintain protective fencing around existing trees and vegetation as shown on the drawings.
   2. Individual trees will have protective fencing built beyond drip line.
   3. Build protective fencing around groups of trees and other vegetation as indicated on Drawings.
   4. Keep areas within protective fencing undisturbed and do not use for any purpose.
   5. Remove and replace vegetation that dies or is damaged beyond repair due to construction activities.

E. Environmental Protection:
   1. Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and reduce possibility that air, waterways, and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment that produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near site.
   2. Provide protection against weather (rain, winds, storms, frost, or heat) to maintain all work, materials, apparatus, and fixtures free from injury or damage.

F. Protection Of Existing Improvements: Protect streets, private roads, and sidewalks, including overhead protection where required. Repair damage to existing improvements caused by construction activities.

G. Protection Of Adjacent Property: Provide necessary protection for adjacent property and lateral support thereof.

3.6 TEMPORARY CONTROLS

A. Dewatering Facilities And Drains: Protect excavation, trenches, and building from damage from rain water, spring water, ground water, backing up of drains or sewers, and all other water. For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with requirements of applicable local regulations. Where feasible, use permanent facilities. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. Filter out excessive amounts of soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways before discharge.

B. Weed Control: Comply with governing ordinances relating to weed control and removal.

3.7 PROJECT IDENTIFICATION

A. Project Identification And Temporary Signs:
   1. Contractor may, at his option, erect a temporary project identification sign. Sign may be free-standing or attached to temporary field office or storage shed. No other signs or advertisements are allowed on building site.
   2. Owner reserves the right to remove and/or take possession of any Project identification sign.
   3. Provide a temporary Project Identification sign. Sign may be free-standing or attached to temporary field office or storage shed. No other signs or advertisements are allowed on building site.
   4. Sign will be no larger than 4 feet by 8 feet and include following information:
      a. Project Name as shown in Contract Documents.
      b. Contractor's name.
      c. Architectural firm name.
   5. Owner reserves the right to remove and/or take possession of any Project identification sign.

END OF SECTION

SECTION 01 1600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Includes But Not Limited To
   1. Administrative and procedural requirements governing Contractor's selection of products for use in Project.

B. Related Sections
   1. Section 01300, Submittals - Contractor's Construction Schedule and Schedule of Submittals
   2. Section 01400, Quality Requirements - Definitions and Standards for applicability of industry standards to products specified.

C. Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on building exterior.
   1. Locate required product labels and stamps on concealed surface or, where required for observation after installation, on accessible surface that is not conspicuous.
   2. Provide permanent nameplates on items of service-connected or power-operated equipment. Locate on easily accessible surface that is inconspicuous in occupied spaces. Nameplate shall contain following information and other essential operating data -
      a. Name of product and manufacturer.
      b. Model and serial number.
      c. Capacity.
      d. Speed.
      e. Ratings.

D. The Owner’s General and Supplemental Conditions supercede the requirements of this section, if more stringent.

1.2 PRODUCT DELIVERY, STORAGE, & HANDLING

A. Deliver, store, and handle products according to manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
   1. Schedule delivery to reduce long-term storage at 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 site 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 upon delivery to ensure compliance with Contract Documents, and to ensure that products are undamaged and properly protected.
   5. Store products at site in manner that will simplify inspection and measurement of quantity or counting of units.
   6. Store heavy materials away from Project structure so supporting construction will not be endangered.
   7. Store products subject to damage by elements above ground, under cover in weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS

A. When option of selecting between two or more products is given, product selected shall be compatible with products previously selected, even if previously selected products were also options.

B. Provide products that comply with Contract Documents, that are undamaged, and unless otherwise indicated, new and unused at time of installation. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for complete installation and for intended use and effect.

C. Product selection is governed by Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include

1. Substitutions -
   a. Where heading ‘Approved Manufacturers’ is used to identify list of specified products or manufacturers and statement 'Equal as approved by Architect before bidding. See Section 01600' is not included, provide only one of products specified. No substitutions or mixing of manufacturers’ products is allowed.
   b. Where heading ‘Acceptable Manufacturers’ is used to identify list of specified products or manufacturers and statement 'Equal as approved by Architect before bidding. See Section 01600' is included, use specified products and manufacturers unless approval to use other products and manufacturers has been obtained by Addendum after following requirements in Instructions To Bidders relative to substitutions.
   c. Where heading ‘Acceptable Manufacturers’ is used to identify list of specified products or manufacturers and statement 'Equal as approved by Architect before installation. See Section 01600' is included, use specified products and manufacturers unless approval to use other products and manufacturers has been obtained from Architect in writing before installing products.
   d. Where heading ‘Quality Standard’ is used to identify specified product or manufacturer, use specified product and manufacturer unless approval to use other products and manufacturers has been obtained from Architect in writing before installing products. If other manufacturers are listed, product to be submitted for Architect’s approval and used shall be product of one of listed manufacturers.
   e. Non-conforming work as covered in Article 12.3 of General Conditions applies but is not limited to use of non-specified products or manufacturers.
2. Where specifications describe a product or assembly by specifying exact characteristics required, with or without use of brand or trade name, provide product or assembly that provides specified characteristics and otherwise complies with Contract requirements.
3. Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by manufacturer for application described. General overall performance of product is implied where product is specified for specific application. Manufacturer's recommendations may be contained in published product literature, or by manufacturer's certification of performance.
4. Where specifications only require compliance with an imposed code, standard, or regulation, select product that complies with standards, codes or regulations specified.
5. Where Specifications require matching an established Sample, Architect's decision will be final on whether proposed product matches satisfactorily. Where no product available within specified category matches satisfactorily nor complies with other specified requirements, refer to Architect.
6. Where specified product requirements include phrase ` . . . as selected from manufacturer's standard colors, patterns, textures . . . ' or similar phrase, select product and manufacturer that comply with other specified requirements. Architect will select color, pattern, and texture from product line selected.
7. Remove and replace products and materials not specified in Contract Documents but installed in the Work with specified products and materials at no additional cost to Owner and for no increase in Contract time.

END OF SECTION

SECTION 01 1700

EXECUTION REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Includes But Not Limited To
   1. Administrative and procedural requirements for installation, demolition, and cleaning.
   2. Administrative and procedural requirements for project closeout, including
      a. Project record document submittal.
      b. Operations & maintenance manual submittal.
      c. Submittal of warranties.

B. Related Sections
   1. Closeout requirements for specific construction activities are included in appropriate Sections in Divisions 02 through 16.

C. The Owner's General and Supplemental Conditions supercede the requirements of this section, if more stringent.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Bracing, Shoring, & Sheathing - Design, furnish, and install all shoring, bracing, and sheathing as required for safety and for proper execution of the Work and have same removed if required when the Work is completed.

3.2 GENERAL INSTALLATION PROVISIONS

A. Inspection of Conditions - Require installer of each major component to inspect both substrate and conditions under which Work is to be done. Notify Architect in writing of unsatisfactory conditions. Do not proceed until unsatisfactory conditions have been corrected.

B. Manufacturer's Instructions - Comply with Manufacturer's installation instructions and recommendations, to extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents. Notify Architect of conflicts between Manufacturer's installation instructions and Contract Document requirements.

C. Inspect materials or equipment before installation. Reject damaged and defective items.

D. Provide attachment and connection devices and methods necessary for securing Work. Secure work true to line and level. Anchor each product securely in place, accurately located, and aligned with other Work. Allow for expansion and building movement.

E. Visual Effects - Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain best visual effect. Refer questionable choices to Architect for final decision.

F. Recheck measurements and dimensions before starting each installation.

G. Install each component during weather conditions and Project status that will ensure best

possible results. Isolate each part of completed construction from incompatible material as necessary to prevent deterioration.

H. Coordinate temporary enclosures with required inspections and tests, to reduce necessity of uncovering completed construction for that purpose.

I. Mounting Heights - Where mounting heights are not shown, install individual components at standard mounting heights recognized within the industry or local codes for that application. Refer questionable mounting height decisions to Architect for final decision.

3.4 CLEANING

A. Progress Cleaning
   1. Comply with regulations of authorities having jurisdiction and safety standards for cleaning.
   2. Keep premises broom clean during progress of the Work.
   3. During performance of demolition, keep building, site, and adjoining streets reasonably clean, and sweep areas affected by demolition operations daily. If necessary, sprinkle rubbish and debris to lay dust.
   4. During handling and installation, protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from soiling, damage, or deterioration until Substantial Completion.
   5. Clean and maintain completed construction as frequently as necessary throughout construction period. Adjust and lubricate operable components to ensure ability to operate without damaging effects.
   6. Supervise construction activities to ensure that no part of construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.
   7. Before and during application of painting materials, clear area where such work is in progress of debris, rubbish, and building materials that may cause dust. Sweep floors and vacuum as required and take all possible steps to keep area dust free.
   8. Collection & Disposal of Waste -
      a. Remove waste materials and rubbish caused by employees, Subcontractors, and contractors under separate contract with Owner and dispose of legally. Remove unsuitable or damaged materials and debris from building and from property.
         1) Provide adequate waste receptacles and dispose of materials when full.
         2) Properly store volatile waste and remove daily.
         3) Do not deposit waste into storm drains, sanitary sewers, streams, or waterways. Do not discharge volatile, harmful, or dangerous materials into drainage systems.
      b. Do not burn waste materials. Do not bury debris or excess materials on Owner's property.
   9. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until time of Substantial Completion.
   10. Where extra materials of value remaining after completion of associated Work have become Owner's property, arrange for disposition of these materials as directed.

B. Final Cleaning
   1. Clean each surface or unit to condition expected in normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions. Remove all rubbish from under and about building and leave building clean and habitable.
   2. In addition to general cleaning noted above, perform cleaning for all trades at completion of work in areas where construction activities have occurred, including -

      a. Interior -
         1) Wash and polish inside glazing, exercising care not to scratch glass.

Replace chipped or broken glass and other damaged glazing materials.

2) Remove marks, stains, fingerprints and other soil, and dirt from painted, decorated, and stained work.
3) Clean and polish woodwork.
4) Remove labels that are not permanent labels.
5) Clean and polish hardware for all trades. This shall include removal of stains, dust, dirt, paint, etc.
6) Remove spots, soil, and paint and wash tilework.
7) Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
8) Clean other fixtures and equipment and remove stains, paint, dirt, and dust.
9) Remove temporary floor protection and clean floors. Spray buff resilient flooring.
10) Clean metal surfaces, including doors and windows, required to have polished finishes. Polish surfaces, leaving them without fingerprints or other blemishes.

b. Exterior -
1) Wash and polish outside glazing, exercising care not to scratch glass.
2) Remove marks, stains, and dirt from exterior surfaces of building.
3) Clean and polish hardware for all trades. This shall include removal of stains, dust, dirt, paint, etc.
4) Clean fixtures and equipment and remove stains, paint, dirt, and dust.
5) Remove temporary protection systems.
6) Clean all dirt, mud, and other foreign material from paving, sidewalks, and gutters.
7) Clean drop inlets, through-curb drains, and other drainage structures.
8) Remove trash, debris, and foreign material from landscaped areas.

3. If Contractor fails to clean up, Owner may do so and charge cost to Contractor.

3.5 CLOSEOUT PROCEDURES

A. Substantial Completion Inspection
1. Upon receipt of notice that the Work is complete except items whose completion has been delayed because of circumstances acceptable to Architect, Architect will arrange substantial completion inspection to include Owner's representatives. Architect will also notify Contractor and Owner in writing of time and place of inspection. Upon completion of inspection, unless building is rejected, Architect will prepare a certificate of final acceptance. Owner, Architect, and Contractor will execute a Certificate of Substantial Completion that states dates for -
a. User occupancy
b. Commencement of warranties
c. Modifications to amount assessed for liquidated damages
2. After inspection and if necessary, Architect will furnish final Punch List of items to be corrected.

B. Final Acceptance Meeting
1. Before requesting final inspection for certification of final acceptance and final payment, complete following. List exceptions in request.
a. Submit final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
b. Submit updated final statement, accounting for final additional changes to Contract Sum.
c. Submit copy of Architect's final inspection Punch List of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and list has been endorsed and dated by Architect.

2. If all items have not been corrected as agreed, Owner may elect to complete the Work under provisions of the General Conditions.

3.6 CLOSEOUT SUBMITTALS

A. General
1. Refer to other specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the Work. Immediately before date of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to Architect for Owner's records.
2. Final payment for Project will not be made until closeout submittals have been completed, submitted, and approved.

B. Operations & Maintenance Manuals
1. Contractor will deliver to Owner a set of binders containing Operations & Maintenance Data and Product Data.
2. Include following information in Operations & Maintenance Manuals -
   a. Copy of complete Project Manual including addenda and copies of other written construction documents such as Change Orders and interpretations issued during construction.
      1) Mark these documents to show variations in actual Work performed in comparison with text of specifications and Modifications. Show substitutions, selection of options, and similar information, particularly on elements that are concealed or cannot otherwise be readily discerned later by direct observation.
      2) Note related record drawing information and Product Data.
   b. Product Data - One copy of each Product Data submittal as specified in Section 01300.
   c. Operations & maintenance manuals required by Divisions and Sections of the specifications.
   d. Certifications.
   e. Copies of specified warranties.

C. Preventative Maintenance Instructions
1. Arrange for each installer of equipment that requires regular maintenance to meet with Owner's personnel to provide instruction in proper operation and maintenance as specified in specification Sections. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include detailed reviews of following items
   a. Maintenance manuals.
   b. Record documents.
   c. Spare parts and materials.
   d. Tools.
   e. Lubricants.
   f. Fuels.
   g. Identification systems.
   h. Control sequences.
   i. Hazards.
   j. Cleaning.
   k. Warranties and bonds.
   l. Maintenance agreements and similar continuing commitments.
2. As part of instruction for operating equipment, demonstrate following procedures
   a. Start-up.
   b. Shutdown.
   c. Emergency operations.
   d. Noise and vibration adjustments.

e. Safety procedures.
f. Economy and efficiency adjustments.
g. Effective energy use.

D. Project Record Documents
1. Do not use record documents for construction purposes. Protect from deterioration and loss in secure, fire-resistive location. Provide access to record documents for Architect's reference during normal working hours.
2. Maintain clean, undamaged set of blue or black line white-prints of Contract Drawings. Mark set to show actual installation where installation varies from the Work as originally shown. Give particular attention to concealed elements that would be difficult to measure and record at later date.
   a. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work.
   b. Mark new information that is important to Owner, but was not shown on Contract Drawings.
   c. Note related Change Order numbers where applicable.
   d. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on cover of each set.

E. Warranties
1. When written guarantees beyond one year after substantial completion are required of any Section of the Work, Contractor shall secure such guarantees and/or warranties properly addressed and signed and in favor of Owner. Include these documents in Operations & Maintenance Manuals specified above.
2. Delivery of guarantees and warranties shall not relieve Contractor from any obligation assumed under any other provisions of his contract.
3. Nothing in this Section intends or implies that guarantees and/or warranties shall apply to work abused or neglected by Owner.

END OF SECTION

DIVISION 03: CONCRETE

03 1000 CONCRETE FORMING AND ACCESSORIES

03 1511 ANCHORS & INSERTS

03 2000 CONCRETE REINFORCING

03 2100 REINFORCING STEEL

03 3000 CAST-IN-PLACE CONCRETE

03 3111 NORMAL WEIGHT STRUCTURAL CONCRETE

03 9000 CONCRETE RESTORATION

03 9210 PARGE COAT

END OF TABLE OF CONTENTS

SECTION 03 1511

ANCHORS AND INSERTS

PART 1 - GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section:
   1. Concrete anchors and inserts not specified elsewhere.

B. Related Sections:
   1. Section 03 3111: Installation.
   2. Section 05 0523: Quality of anchor bolts.

1.2 SUBMITTALS

A. Product Data: Manufacturer's product literature for each item.

B. Quality Assurance / Control: Manufacturer's installation recommendations for each item.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Adhesive Anchors:
   1. Type Two Acceptable Products:
      a. Ultrabond by Adhesives Technology Corp.
      b. HIT HY-150 System by Hilti.
      c. Power-Fast System by Powers Fastening.
      d. EPCON System by Ramset / Redhead.
      e. SET Adhesive by Simpson.
      f. Equal as approved by Architect before installation. See Section 01 6000.

B. Drilled-In Anchors:
   1. Type Two Acceptable Products:
      a. Wedge Anchors by Adhesives Technology Corp.
      b. Kwik Bolts by Hilti.
      c. SUP-R-STUDS by MKT Fastening.
      d. Power-Stud by Powers Fastening.
      e. TruBolt Carbon Wedge Anchors by Ramset / Redhead.
      f. Wedge-All Wedge Anchors by Simpson.
      g. Equal as approved by Architect before installation. See Section 01 6000.

2.2 MANUFACTURERS

A. Contact Information:
   1. Adhesives Technology Corp, Pampano Beach, FL www.usanchor.net.
   2. Hilti Fastening Systems, Tulsa, OK www.hilti.com.
   3. ITW Ramset / Redhead, Wood Dale, IL www.ramset-redhead.com.
   4. MKT Fastening Corp, Lonoke, AR www.mktfastening.com.
   5. Powers Fastenings Inc, New Rochelle, NY www.powers.com.

6. Simpson Strong-Tie, Dublin,CA www.strongtie.com.

2.3 EXECUTION

2.4 INSTALLATION

A. Epoxy Anchors:

B. Drilled-In Anchors:

END OF SECTION

SECTION 03 2100

REINFORCING STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install concrete reinforcing steel as described in Contract Documents.

1.2 REFERENCES

A. American Concrete Institute:
   1. ACI 318-83.

B. American Society For Testing And Materials:
   1. ASTM A 615-00, 'Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.'

1.3 SUBMITTALS

A. Quality Assurance / Control:
   1. Reinforcing placement drawings.
   2. Mill certificates.

1.4 QUALITY ASSURANCE

A. Certification: Mill tests for reinforcing in accordance with ASTM A 615.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Reinforcing steel shall be free of heavy rust scales and flakes, or other coating at time of delivery and placing. Properly protect rebar on site after delivery.

B. Deliver bars separated by size and tagged with manufacturer's heat or test identification number.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Reinforcing Steel:
   1. Reinforcing bars shall have grade identification marks and conform to ASTM A 615.
      a. Grade 60 minimum, except dowels that are to be field bent, Grade 40 minimum.
      b. Bars shall be deformed type.
      c. Bars shall be free of heavy rust scales and flakes, or other bond-reducing coatings.

B. Bar Supports:
   1. Type Two Acceptable Products:
      a. Concrete 'dobies' or blocks wired to reinforcing.
      b. Manufactured chairs with 4 sq in bearing surface with sub-grade, or other feature to prevent chair from being pushed into sub-grade.
      c. Equals as approved by Architect before installation. See Section 01 6200.

2.2 FABRICATION

A. Fabricate reinforcing steel according to 'ACI Detailing Manual,' 1988 edition, and details on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Bend bars cold.

B. Accurately place and support with chairs, bar supports, spacers, or hangers as recommended by 'ACI Detailing Manual,' 1988 edition, except slab on grade work. Support bars in slabs on grade and footings with specified bar supports around perimeter and at 4-1/2 feet on center each way maximum to maintain specified concrete cover. Install bar supports at bar intersections.

C. Dowel vertical reinforcement for formed concrete columns or walls out of footing or structure below with rebar of same size and spacing required above.

D. Securely anchor and tie reinforcing bars and dowels before placing concrete. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Avoid splices of reinforcing bars at points of maximum stress. Lap bars 40 bar diameters minimum unless dimensioned otherwise on Drawings. Run steel reinforcing bars continuous through cold joints.

END OF SECTION

SECTION 03 3111

NORMAL WEIGHT STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install Project concrete work as described in Contract Documents.
   2. Quality of concrete used on Project but furnished under other Sections.

B. Products Installed But Not Supplied Under This Section:
   1. Inserts, bolts, boxes, templates, and fastening devices for other work, including those for bases only for Mechanical and Electrical.
   2. Concrete accessories.

C. Related Sections:
   1. Divisions 22, 23, And 26: Mechanical and electrical devices including boxes, conduits, pipes, hangers, inserts, and other work to be embedded in concrete work before placing.
   2. Section 31 2324: Granular base course under slabs.
   3. Section 32 1313: Concrete paving.
   4. Section 32 3213: Cast-in-place retaining walls.
   5. Furnishing of items to be embedded in concrete specified in Section involved.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM C 33-03, 'Standard Specification for Concrete Aggregates.'
   2. ASTM C 94-03, 'Standard Specification for Ready-Mixed Concrete.'
   3. ASTM C 150-04, 'Standard Specification for Portland Cement.'
   4. ASTM C 260-01, 'Standard Specification for Air-Entraining Admixtures for Concrete.'
   5. ASTM C 494-04, 'Standard Specification for Chemical Admixtures for Concrete.'
   6. ASTM C 618-03, 'Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.'
   7. ASTM E 1155-96 (2001), 'Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.'

1.3 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Conform to requirements of ASTM C 94 unless specified otherwise.
   2. For testing purposes, following concrete strengths are required:
      a. At 7 days: 60 percent minimum of 28 day strengths.

1.4 SUBMITTALS

A. Shop Drawings: Show dimensioned locations of anchor bolts for hold-down anchors and columns.

B. Quality Assurance / Control:
   1. Concrete mix design.

2. Delivery Tickets: Require mix plant to furnish delivery ticket for each batch of concrete. Keep delivery tickets at job-site for use of Owner or his representatives. Tickets shall show following:
   a. Name of ready-mix batch plant.
   b. Serial number of ticket.
   c. Date and truck number.
   d. Name of Contractor.
   e. Name and location of Project.
   f. Specific class or designation of concrete conforming to that used in Contract Documents.
   g. Amount of concrete.
   h. Time loaded.
   i. Type, name, manufacturer, and amount of admixtures used.
   j. Amount and type of cement.
   k. Total water content.
   l. Sizes and weights of sand and aggregate.

1.5 QUALITY ASSURANCE

A. Pre-Installation Conference:
   1. Schedule pre-installation conference after placing of footings, installation of foundation forms and reinforcing steel, and installation of anchors, dowels, inserts, and block outs in foundation walls and slabs, but before placing of concrete.
   2. In addition to agenda items specified in Section 01 3100, review following:
      a. Approved mix design and use of admixtures.
      b. Installation scheduling, coordination, and placement of items installed in and under floor slab.
      c. Placement, finishing, and curing of concrete including cold and hot weather requirements.
      d. Concrete slab tolerances and corrective measures if tolerances not met.

1.6 PROJECT CONDITIONS

A. Project Environmental Requirements:
   1. Cold Weather Concreting Procedures:
      a. General Requirements:
         1) Contactor shall monitor and record daily high and low temperatures in Daily Logs and keep available for inspection on site at all times.
         2) Materials and equipment required for heating and protection of concrete shall be approved and available at Project site before beginning cold weather concreting.
         3) Forms, reinforcement, metallic embedments, and fillers shall be free from snow, ice, and frost. Surfaces that will be in contact with newly placed concrete, including sub-grade materials, shall be 35 deg F minimum at time of concrete placement.
         4) Thaw sub-grade 6 inches deep minimum before beginning concrete placement. If necessary, re-compact thawed material.
         5) Use no frozen materials or materials containing ice.
      b. Requirements When Average 24 Hour Temperature, midnight to midnight, Is Below 40 deg F:
         1) Temperature of concrete as placed and maintained shall be 55 deg F minimum and 75 deg F maximum.
         2) Heat concrete for 72 hours minimum after placing if regular cement is used; for 48 hours if high early strength cement is used; or longer if determined necessary by Architect. During this period, maintain concrete surface temperature between 55 and 75 deg F.
         3) Vent flue gases from combustion heating units to outside of enclosure to prevent carbonation of the concrete surface.
         4) Prevent concrete from drying during heating period. Maintain housing, insulation, covering, and other protection 24 hours after heat is discontinued.
         5) After heating period, if temperature falls below 32 deg F, protect concrete from freezing until strength of 2000 psi minimum is achieved. Protect flatwork exposed to melting

snow or rain during day and freezing during night from freezing until strength of 3500 psi minimum is achieved.

c. Requirements When Average 24 Hour Temperature, midnight to midnight, Is Above 40 deg F, but when temperature falls below 32 deg F:

1) Protect concrete from freezing for 72 hours after placing, or until a strength of 2000 psi is achieved, whichever is longer. Protect flatwork exposed to melting snow or rain during day and freezing during night from freezing until strength of 3500 psi minimum is achieved.

d. Protect soil supporting concrete footings from freezing under any circumstances.

2. Hot Weather Concreting Procedures:

a. Maximum concrete temperature allowed is 90 deg F in hot weather.

b. Cool aggregate and subgrades by sprinkling.

c. Avoid cement over 140 deg F.

d. Use cold mixing water or ice.

e. Use fog spray or evaporation retardant to lessen rapid evaporation from concrete surface.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: Meet requirements of ASTM C 150, Type <**Insert Type**>.

B. Aggregates:

1. Coarse:

a. Meet requirements of ASTM C 33 or nonconforming aggregate that by test or actual service produces concrete of required strength and conforms to local governing codes.

b. Aggregate shall be uniformly graded by weight as follows:

1) Flat Work, Size No. 67.

Sieve	Percent Passing		
One Inch	100		
3/4 Inch	90 - 100		
3/8 Inch	20 - 55		
No. 4	0 - 10		
No. 8	0 - 5		

2) All Other, Size No. 57.

Sieve	Percent Passing		
1-1/2 Inch	100		
One Inch	95 - 100		
1/2 Inch	25 - 60		
No. 4	0 - 10		
No. 8	0 - 5		

2. Fine:

a. Meet requirements of ASTM C 33.

b. Aggregate shall be uniformly graded by weight as follows:

Sieve	Percent Passing		
3/8 Inch	100		
No. 4	95 - 100		
No. 8	80 - 100		
No. 16	50 - 85		
No. 30	25 - 60		
No. 50	10 - 30		
No. 100	2 - 10		

C. Water: Clear, apparently clean, and potable.

D. Admixtures And Miscellaneous:
   1. Mineral:
      a. Fly Ash Pozzolan: Meet requirements of ASTM C 618, Class F or C and with loss on ignition (LOI) of 3 percent maximum.
   2. Chemical:
      a. No admixture shall contain calcium chloride nor shall calcium chloride be used as an admixture. All chemical admixtures used shall be from same manufacturer and compatible with each other.
      b. Air Entraining Admixture:
         1) Meet requirements of ASTM C 260.
         2) Type Two Acceptable Products:
            a) Air Mix 200 or AEA-92 by Euclid.
            b) Air plus or Super Air Plus by Fritz-Pak.
            c) MB-VR, MB-AE or Micro Air by Master Builders.
            d) Sika Air by Sika.
            e) Daravair or Darex II AEA by W R Grace.
            f) Equal as approved by Architect before use. See Section 01 6200.
      c. Water Reducing Admixture:
         1) Meet requirements of C 494, Type A and containing not more than 0.05 percent chloride ions.
         2) Type Two Acceptable Products:
            a) Eucon WR 75 or Eucon 91 by Euclid.
            b) FR-2 or FR-3 by Fritz-Pak.
            c) Pozzolith Series by Master Builders.
            d) Plastocrete 160 by Sika.
            e) Daracem 50/55, WRDA-64, or WRDA-82 by W R Grace.
            f) Equal as approved by Architect before use. See Section 01 6200.
      d. Water Reducing, Retarding Admixture:
         1) Meet requirements of ASTM C 494, Type D and contain not more than 0.05 percent chloride ions.
         2) Type Two Acceptable Products:
            a) Eucon Retarder 75 by Euclid.
            b) FR-1 or Modified FR-1 by Fritz-Pak.
            c) Pozzolith Series by Master Builders.
            d) Plastiment by Sika.
            e) Daratard-17 or Daratard-40 by W R Grace.
            f) Equal as approved by Architect before use. See Section 01 6200.
      e. High Range Water Reducing Admixture (Superplasticizer):
         1) Meet requirements of ASTM C 494, Type F or G and containing not more than 0.05 percent chloride ions.
         2) Type Two Acceptable Products:
            a) Eucon 37 or Eucon 537 by Euclid.
            b) Supercizer 1 through 7 by Fritz-Pak.
            c) Rheobuild 1000 or Glenium Series by Master Builders.
            d) Sikament 300 by Sika.
            e) Darachem-100 or WRDA-19 by W R Grace.
            f) Equal as approved by Architect before use. See Section 01 6200.
      f. Non-Chloride, Non-Corrosive Accelerating Admixture:
         1) Meet requirements of ASTM C 494, Type C or E and not contain more chloride ions than are present in municipal drinking water.
         2) Type Two Acceptable Products:
            a) Accelguard 80 by Euclid.
            b) Pozzolith NC 534 or 122HE or Pozzutec 20+
            c) Daraset or Polarset by W R Grace.
            d) Equal as approved by Architect before use. See Section 01 6200.
   3. Evaporation Retardant:
      a. Type Two Acceptable Products:
         1) Sure Film J-74 by Dayton Superior.
         2) Euco-Bar By Euclid Chemical Co.
         3) E-Con by L & M Construction Chemicals.

4) Confilm by Master Builders.
5) Pro Film by Unitex.
6) U S Spec Monofilm ER by U S Mix Products.
7) Equal as approved by Architect before use. See Section 01 6200.

4. Bonding Agents:
   a. Type Two Acceptable Products:
      1) Day Chem Ad Bond (J-40) by Dayton Superior.
      2) Flex-Con by Euclid Chemical Co.
      3) Larsen Weldcrete by Larsen Products Corp.
      4) Everbond by L & M Construction Chemicals.
      5) Acryl Set by Master Builders.
      6) Sonocrete by Sonneborn.
      7) Tamms Bond by TAMMS Industries.
      8) U S Spec Multicoat by U S Mix Products.
      9) Acrylic Additive by W R Bonsal.
      10) Intralok by W R Meadows.
      11) Equal as approved by Architect before use. See Section 01 6200.

2.2 MANUFACTURERS

A. Contact Information:
   1. Bonsal American, Charlotte, NC www.bonsal.com.
   2. Dayton Superior Concrete Chemicals, Miamisburg, IL www.daytonsuperiorchemical.com.
   3. Euclid Chemical Company, Cleveland, OH www.euclidchemical.com.
   4. Fritz-Pak Concrete Admixtures, Dallas, TX www.fritzpak.com.
   5. Grace Construction Products, Cambridge, MA www.graceconstruction.com.
   6. L & M Construction Chemicals, Omaha, NE www.lmcc.com.
   7. Larsen Weldcrete by Larsen Products Corp, Rockville, MD www.larsenproducts.com.
   8. Master Builders / deGussa Admixtures, Cleveland, OH www.masterbuilders.com.
   9. Sika Corporation, Lyndhurst, NJ www.sikaconstruction.com.
   10. Sonneborn / deGussa Building Systems, Shakopee, MN www.chemrex.com.
   11. TAMMS Industries, Mentor, OH www.tamms.com.
   12. Unitex, Kansas City, MO www.unitex-chemicals.com.
   13. U S Mix Products Co, Denver, CO www.usspec.com.
   14. W R Meadows, Hampshire, IL www.wrmeadows.com.

2.3 MIXES

A. Submit mix designs to meet following requirements:
   1. Proportions:
      a. Mix Type 1:
         1) Minimum weight cement per cu yd concrete: 517 lbs.
         2) Water **/** Cement Ratio: 0.50 maximum by weight.
      b. Mix Type 2:
         1) Minimum weight cement per cu yd concrete: 564 lbs.
         2) Water **/** Cement Ratio: 0.45 maximum by weight.
      c. Air Entrainment:
         1) Exterior Concrete: 6 percent, plus or minus 1-1**/**2 percent.
      d. Do not add water any time during mixing cycle above amount required to meet specified water / cement ratio. No reduction in the amount of cementitious material is allowed.
   2. Admixtures:
      a. Mix design shall show proposed admixture, amount, usage instructions, and justification for proposed use. Do not use any admixture without Architect's written approval.
      b. Mineral: An amount of specified fly ash not to exceed 20 percent of weight of cement may be substituted for cement. If substituted, consider fly ash with cement in determining amount of water necessary to provide specified water / cement ratio.
      c. Chemical:

1) 4 inch slump maximum before addition of high range water reducer.
2) 8 inch slump maximum with use of high range water reducer.
3) Specified accelerator or retarder may be used if necessary to meet environmental conditions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Inserts, bolts, boxes, templates, pipes, conduits, and other accessories required by Divisions 22, 23, and 26 shall be installed and inspected before placing concrete.

B. Install inserts, bolts, boxes, templates, pipes, conduits, and other accessories furnished under other Sections to be installed as part of work of this Section. Tie anchor bolts for hold-down anchors and columns securely to reinforcing steel.

C. Remove water and debris from space to be placed.

3.2 INSTALLATION

A. Special Techniques:
1. Cold Weather Concreting Procedures:
   a. General Requirements:
      1) Materials and equipment required for heating and protection of concrete shall be approved and available at Project site before beginning cold weather concreting.
      2) Forms, reinforcement, metallic embedments, and fillers shall be free from snow, ice, and frost. Surfaces that will be in contact with newly placed concrete, including sub-grade materials, shall be 35 deg F minimum at time of concrete placement.
      3) Thaw sub-grade 6 inches deep minimum before beginning concrete placement. If necessary, re-compact thawed material.
      4) Use no frozen materials or materials containing ice.
   b. Requirements When Average 24 Hour Temperature, midnight to midnight, Is Below 40 deg F:
      1) Temperature of concrete as placed and maintained shall be 55 deg F minimum and 75 deg F maximum.
      2) Heat concrete for 72 hours minimum after placing if regular cement is used; for 48 hours if high early strength cement is used; or longer if determined necessary by Architect. During this period, maintain concrete surface temperature between 55 and 75 deg F.
      3) Vent flue gases from combustion heating units to outside of enclosure to prevent carbonation of the concrete surface.
      4) Prevent concrete from drying during heating period. Maintain housing, insulation, covering, and other protection 24 hours after heat is discontinued.
      5) After heating period, if temperature falls below 32 deg F, protect concrete from freezing until strength of 2000 psi minimum is achieved. Protect flatwork exposed to melting snow or rain during day and freezing during night from freezing until strength of 3500 psi minimum is achieved.
   c. Requirements When Average 24 Hour Temperature, midnight to midnight, Is Above 40 deg F, but when temperature falls below 32 deg F:
      1) Protect concrete from freezing for 72 hours after placing, or until a strength of 2000 psi is achieved, whichever is longer. Protect flatwork exposed to melting snow or rain during day and freezing during night from freezing until strength of 3500 psi minimum is achieved.
   d. Protect soil supporting concrete footings from freezing under any circumstances.
2. Hot Weather Concreting Procedures:
   a. Maximum concrete temperature allowed is 90 deg F in hot weather.

b. Cool aggregate and subgrades by sprinkling.
c. Avoid cement over 140 deg F.
d. Use cold mixing water or ice.
e. Use fog spray or evaporation retardant to lessen rapid evaporation from concrete surface.

B. Site Tolerances:
1. Tolerances shall conform to requirements of ACI 117, except where specified differently.
2. Local Flatness / Levelness of Interior Slabs:
a. Specified Overall Value of F_F28 / F_L20 and Minimum Local Value of F_F20 / F_L15 when tested in accordance with ASTM E 1155.
b. Table Four: Maximum Variation Tolerances.

Thickness, standard	plus 3/8 inch, minus 1/4 inch	
Thickness, footings	minus 0 inch	
Plan, 0 - 20 feet	1/2 inch	
Plan, 40 feet or greater	3/4 inch	
Plan, footings	plus 1/2 inch	
Eccentricity, footings	2 inch max standard, 1/2 inch at masonry	
Openings, size	minus 1/4 inch, plus One inch	
Openings, location	plus / minus 1/2 inch at center	
Plumb	1/2 inch max	
Consecutive Steps, treads	1/4 inch	
Consecutive Steps, risers	1/8 inch	
Flight of Stairs, treads	1/4 inch in total run	
Flight of Stairs, risers	1/8 inch in total height	

1. Remedy For Out-of-Tolerance Building Slabs:
a. Remove and replace sections of slabs measuring outside specified correctable tolerances.

C. Placing:
1. Place as soon after mixing as possible. Deposit as nearly as possible in final position. Placing of concrete shall be continuous until a panel or section is complete.
2. In order to avoid overloading of forms and ties, observe following rate of filling for various air temperatures:
a. Table Five: Placing Rate.

Temperature	Rate of Fill per Hour		
40 deg F	2 feet		
50 deg F	3 feet		
60 deg F	4 feet		
70 deg F	5 feet		

3. Compact concrete in forms by vibrating and other means where required. Thoroughly work in concrete around reinforcing bars.
4. Do not embed aluminum in concrete.
5. Do not use contaminated, deteriorated, or re-tempered concrete.
6. Avoid accumulation of hardened concrete.
7. Footings:
a. Bear 12 inches minimum into undisturbed earth or on mechanically compacted engineered fill. Step footings at ratio of 1-1/2 horizontal to One vertical unless detailed otherwise. Exterior wall footing shall bear 30 INCHES minimum below finish grades.
b. Level top of finish footing and leave rough.
c. Where joints are required, bulkhead, key horizontally, and dowel with two No. 5 reinforcing bars, 48 inches long.
8. Foundations And Walls: Leave steel projecting where required for floor tie.
9. Slabs:
a. Dusting with cement not permitted.
b. For continuous placing and where shown on Drawings, saw cut one inch deep control joints before shrinkage occurs.
c. Interior slabs will be exposed for sealed finish.
10. Equipment Bases: Coordinate with appropriate Sections for locations and dimensions.

11. Joints:
    a. Where possible, locate joints under partitions or where joints will cause least disruption to floor coverings.
    b. Construction Joints: Locate where shown on Drawings to least impair strength of completed structure. Construction joints in foundation walls shall not occur within 6 feet of corner and be keyed.
12. Bonding Fresh And Hardened Concrete:
    a. Re-tighten forms.
    b. Roughen surfaces.
    c. Clean off foreign matter and laitance.
    d. Wet but do not saturate.
    e. Slush with neat cement grout or apply bonding agent.
    f. Proceed with placing new concrete.
13. Anchor Bolts: Place anchor bolts not tied to reinforcing steel immediately following leveling of concrete. Reconsolidate concrete around bolt immediately after placing bolt. Do not disturb bolts during finishing process.
14. Substrate For Geocomposite Foundation Drainage System:
    a. Concrete surfaces shall be of sound structural grade and have smooth finish free of fins, ridges, protrusions, rough spalled areas, loose aggregate, exposed course aggregate, voids or entrained air holes. Rough surfaces shall receive well-adhered parge coat.
    b. Repair voids, rock pockets, and excessively rough surfaces with approved non-shrink grout or grind to match unrepaired areas.
    c. Surfaces at cold joints shall be on the same plane.

D. Finishing:
1. Rubbed Finish, Exposed Vertical Surfaces:
    a. Immediately after removing forms, remove joints, marks, bellies, projections, loose materials, and cut back metal ties from surfaces to be exposed.
    b. Point up voids with cement mortar, 1:2 mix, and rub exposed surface with carborundum to smooth, even surface.
2. Steel Trowel Finishes, Interior Flatwork:
    a. Float and steel trowel interior slabs after concrete has set enough to avoid bringing water and fines to surface.
    b. Interior slabs will be exposed, there will be no floor finish over the slab. Finished surface must be smooth, flat, and acceptable for an exposed floor.
    c. If power troweling is used, get approval of finish from Architect.
3. Broom Finishes, Exterior Flatwork Not Specified in Section 03 3053:
    a. Broom finish exterior slabs.
    b. Round edges including edges formed by expansion joints.
    c. Remove edger marks.
4. Rough: Top of slabs and stairs to receive setting bed for ceramic or paver tile.

E. Curing:
1. Interior Slabs:
    a. Water cure as specified in Section 03 3913, unless Cold Weather Concreting Procedures are necessary.
    b. Membrane cure as specified in Section 03 3923, if Cold Weather Concreting Procedures are necessary.
2. Concrete Paving: Membrane cure as specified in Section 03 3923.
3. All Other Concrete Flatwork And Curbs: Membrane cure as specified in Section 03 3923

3.3 FIELD QUALITY CONTROL

A. Inspection: Notify Architect three days minimum before placing concrete for footings, foundation walls, and building slabs.

3.4 ADJUSTING

A. Remedy For Out-of-Tolerance Building Slabs:
   1. Sections of slabs to be covered by carpet, which do not meet specified tolerances but are within 10 percent of specified tolerances, may be corrected by grinding or filling, at Owner's option. Remove and replace sections of slabs measuring outside specified correctable tolerances.
   2. If floor leveling compounds or concrete patching compounds are required to bring floor into specified tolerances in carpeted areas, they will be provided by Owner in conjunction with carpet installation and back-charged to Contractor.

3.5 PROTECTION

A. Protect concrete that has not received its initial set from precipitation to avoid excess water in mix and unsatisfactory surface finish.

B. Do not allow materials resulting from construction activities, which will affect concrete or application of finish floor systems adversely, to come in contact with interior concrete slabs.

END OF SECTION

SECTION 03 9210

PARGE COAT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install concrete foundation wall finishing coat as described in Contract Documents.

B. Related Sections:
   1. Section 03313: Normal weight structural concrete.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM C 144-99, >Standard Specification for Aggregate For Masonry Mortar=.
   2. ASTM C 150-00, 'Standard Specification for Portland Cement.'

1.3 SITE CONDITIONS

A. Environmental Requirements:
   1. Apply when temperature is between 40 and 100 deg F 4.5 and 38 deg C.
   2. Provide protection necessary to maintain application temperatures during curing period.
   3. Protect from physical damage, freezing, and hot winds.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: Meet requirements of ASTM C 150.

B. Water: Clean, drinkable.

C. Sand: Meet requirements of ASTM C 144.

D. Integral Bonding Agent:
   1. Acrylic Admix.
   2. Acceptable Products:
      a. 101 by Larsen Products Corp, Rockville, MD (800) 633-6668 or (301) 776-4595. www.larsenproducts.com
      b. Equal as approved by Architect before use. See Section 01600.

2.2 MIXES

A. Proportions:
   1. Solids: One part cement to three parts sand.
   2. Liquid: One part Acrylic Admixture to three parts water.
   3. Mix solids with minimum amount of liquid required to give workable consistency.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface to receive parge coat finish shall be structurally sound, clean, free from loose materials, dust, dirt, oil, grease, wax, loose paint, mildew, rust, latence, and efflorescence.

B. Sandblast areas embedded with grease or oil to achieve clean surface.

C. Scarify smooth, steel troweled surfaces.

3.2 APPLICATION

A. Float and fill depressions and voids.

B. Apply one coat minimum with 1/8 inch 3 mm minimum thickness per coat.

C. Rub final parged surface with carborundum to smooth, even surface.

END OF SECTION

DIVISION 04: MASONRY

04 0000 MASONRY

04 0513 CEMENT AND LIME MASONRY MORTARING
04 0516 MASONRY GROUTING
04 0520 MASONRY REINFORCING
04 0523 MASONRY ACCESSORIES

04 2000 UNIT MASONRY

04 2223 ARCHITECTURAL CONCRETE UNIT MASONRY

END OF TABLE OF CONTENTS

SECTION 04 0513

CEMENT AND LIME MASONRY MORTARING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of masonry mortar used on Project.

B. Related Sections:
   1. Sections Under 04 2000 Heading: Furnish and install mortar.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM C 144-03, 'Standard Specification for Aggregate for Masonry Mortar.'
   2. ASTM C 150-04, 'Standard Specification for Portland Cement.'
   3. ASTM C 207-01, 'Standard Specification for Hydrated Lime for Masonry Purposes.'

1.3 SUBMITTALS

A. Quality Assurance / Control:
   1. If pre-mixed wet mortar or pre-blended dry mortar mix are to be used, provide certification from Manufacturer or Supplier verifying that mixes meet specification requirements.
   2. If site mixed / blended mortar is to be used, provide written description of proposed method of measuring and mixing of materials.

1.4 PROJECT CONDITIONS

A. Project Environmental Requirements:
   1. Cold Weather Requirements:
      a. Cold weather, as referred to in this Section, is four hours with ambient temperature below 40 deg F 4 deg C in 24-hour period. Do not lay masonry in cold weather unless authorized by Architect.
      b. Heat mixing water and sand as required during cold weather to produce mortar temperatures at application of between 70 and 120 deg F 21 and 49 deg C.
      c. Heat masonry units to 40 deg F 4 deg C minimum when ambient temperature is below 20 deg F minus 7 deg C.
      d. Provide windbreaks during construction if ambient temperature is 35 deg F 2 deg C or below and wind velocities exceed 15 mph 24 kph.
      e. If ambient temperature is 20 deg F minus 7 deg C or below, provide enclosure for masonry under construction with heat sources and maintain temperature in enclosure at 40 deg F 4 deg C minimum.
      f. Keep materials free of ice and snow. Do not lay masonry on frozen material.
   2. Hot Weather Requirements:
      a. Hot weather, as referred to in this Section, is ambient air temperature above 100 deg F 38 deg C or ambient air temperature above 90 deg F 32 deg C with wind velocity 8 mph 13 kph or greater.

b. In hot weather, cool mixing water as necessary to maintain mortar and grout temperatures below 90 deg F 32 deg C.
c. In hot weather, prevent rapid drying of walls by using fog spray or by covering wall with plastic or wet canvas or burlap.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: Meet requirements of ASTM C 150, Type II Low Alkali unless approved otherwise in writing by Architect.

B. Hydrated Lime: Meet requirements of ASTM C 207, Type S.

C. Aggregate:
1. Standard Mortar:
a. Natural or manufactured sand meeting requirements of ASTM C 144 and following:
1) Fineness modulus: 1.6 to 2.5 percent
2) Water demand, ratio by weight: 0.65 percent maximum
3) Grading:

Sieve	Percent Passing	
	Natural Sand	Manufactured Sand
No. 4	100	100
No. 8	95 to 100	95 to 100
No. 16	70 to 100	70 to 100
No. 30	40 to 75	40 to 75
No. 50	10 to 35	20 to 40
No. 100	2 to 15	10 to 25
No. 200	none	0 to 10

Sieve	Percent Passing	
	Natural Sand	Manufactured Sand
5 000 mm	100	100
2 500 mm	95 to 100	95 to 100
1 250 mm	70 to 100	70 to 100
630 mm	40 to 75	40 to 75
315 mm	10 to 35	20 to 40
160 mm	2 to 15	10 to 25
80 mm	none	0 to 100

D. Water: Clean and free of acids, alkalis, and organic materials.

E. Admixtures: Use no admixtures, except for color pigments specified below, without Architect's written permission. Use of any admixture to meet cold weather requirements and admixtures that increase air entrainment are expressly forbidden under all circumstances.

F. Mortar Color Pigment:
1. High purity, chemically inert, unfading, alkali-fast mineral oxides, finely ground and especially prepared for mortar.
2. Color: Field match existing color of mortar for brick
3. Type One Acceptable Products:
a. True Tone Mortar Colors by Davis Colors, Los Angeles, CA www.daviscolors.com.
b. SGS Mortar Colors by Solomon Colors, Springfield, IL www.solomoncolors.com.

c. Equal as approved by Architect before bidding. See Section 01 6200.

2.2 MIXES

A. Unit Masonry Mortar:

1. Minimum Compressive Strength at 28 Days:
   a. Type N: 750 psi 5.2 MPa.
   b. Type S: 1800 psi 6.9 MPa.
2. Parts by Volume:

Type	N	S
Portland Cement	1	1
Hydrated Lime	1	1/2

   a. Damp Loose Sand: 2-1/4 minimum to three maximum, times sum of volumes of cement and lime used. Maintain sand piles in damp, loose condition.
3. Parts by Weight:

Type	N	S
Portland Cement	94 lbs	94 lbs
Hydrated Lime	40 lbs	20 lbs
Dry Sand	360 lbs minimum to 480 lbs maximum.	
Portland Cement	43 kg	43 kg
Hydrated Lime	18 lbs	9 kg
Dry Sand	163 kg minimum to 218 kg maximum	

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 04 0516

MASONRY GROUTING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of masonry grout used on Project.

B. Related Sections
   1. Sections under 04 2000 heading: Furnish and install masonry grout.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM C 94-03, 'Standard Specification for Ready-Mixed Concrete.'
   2. ASTM C 150-04, 'Standard Specification for Portland Cement.'
   3. ASTM C 207-01, 'Standard Specification for Hydrated Lime for Masonry Purposes.'
   4. ASTM C 404-03, 'Standard Specification for Aggregates for Masonry Grout.'
   5. ASTM C 1019-03, 'Standard Test Method for Sampling and Testing Grout.'

1.3 SUBMITTALS

A. Quality Assurance / Control:
   1. If pre-blended dry grout is to be used, provide certification from Manufacturer or Supplier verifying that mixes meet specification requirements.
   2. If grout is to be mixed in field, provide written description of proposed procedure for measuring and mixing of materials.

1.4 PROJECT CONDITIONS

A. Project Environmental Requirements: Install grout under same environmental conditions as specified for mortar.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: Meet requirements of ASTM C 150. Use Type II Low Alkali in exterior walls or in walls subject to moisture, unless approved otherwise in writing by Architect.

B. Hydrated Lime: Meet requirements of ASTM C 207, Type S.

C. Aggregate:
   1. Meet requirements of ASTM C 404, Table 1.
      a. Grading Requirements for Fine Aggregate, Natural, Size 2.

Sieve	Sieve	Percent Passing
No. 4	5 000 mm	100
No. 8	2 500 mm	95 - 100

No. 16	1 250 mm	60 - 100
No. 30	630 mm	35 - 70
No. 50	400 mm	15 - 35
No. 100	160	2 - 15

b. Grading Requirements for Coarse Aggregate, Size 8.

Sieve	Sieve	Percent Passing
1/2 Inch	12 500 mm	100
3/8 Inch	10 000 mm	85 - 100
No. 4	5 000 mm	10 - 30
No. 8	2 500 mm	0 - 10
No. 16	1 250 mm	0 - 5

D. Water: Clean and free of acids, alkalis, and organic materials.

E. Admixtures: No additives are allowed which will increase air entrainment. Other additives may be used as approved in writing by Architect before use.

2.2 MIXES

A. Procedure:
1. Use of pre-blended dry grout mix is allowed only with submission of certification that material specification requirements have been complied with.
2. Use method of measuring and mixing materials that will ensure consistently proportioned grout batches throughout installation of masonry work. No measuring of materials by 'shovels full' is permitted for field mixed grout.
3. Batch, mix, and deliver transit-mixed grout in accordance with requirements of ASTM C 94.

B. Proportions by Volume
1. Water: Enough to give creamy pouring consistency, usually slump of between 8 and 10.

Material	Fine Grout		Coarse Grout	
Portland Cement	One cu ft	0.028 cu m	One cu ft	0.028 cu m
Hydrated Lime (optional)	1/10 cu ft	0.0028 cu m	1/10 cu ft	0.0028 cu m
Damp, Loose Sand	2-1/4 to 3 cu ft	0.063 to 0.084 cu m	2-1/4 to 3 cu ft	0.063 to 0.084 cu m
Pea Gravel	none	none	1 to 2 cu ft	0.028 to 0.056 cu m

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use fine grout for cavities 2 inches 50 mm and smaller in smallest dimension. Use coarse grout for cavities greater than 2 inches 50 mm in smallest dimension.

3.2 FIELD QUALITY CONTROL

A. Site Testing: Test grout used in masonry bearing walls in accordance with ASTM C 1019. Test results of 2000 psi minimum are required.

END OF SECTION

SECTION 04 0520

MASONRY REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section:
   1. Masonry horizontal joint reinforcing.
   2. Steel masonry reinforcing bars.

B. Related Sections:
   1. Sections under 04 2000 heading: Installation.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM A 82-02, 'Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.'
   2. ASTM A 153-01a, 'Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.'
   3. ASTM A 615-04b, 'Standard Specification for Deformed and Plain Steel Bars for Concrete Reinforcement.'
   4. ASTM A 641-98, 'Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.'

1.3 SUBMITTALS

A. Quality Assurance / Control:
   1. Reinforcing bar placement drawings.
   2. Mill certificate.

1.4 QUALITY ASSURANCE

A. Tag continuous joint reinforcing with Manufacturer's name, wire size, and ASTM / CSA specification.

1.5 DELIVERY, HANDLING, AND STORAGE

A. Steel reinforcing bars shall be free of heavy rust scales and flakes, or other bond-reducing coating at time of delivery and placing. Properly protect rebar on site after delivery.

B. Separate steel reinforcing bars by size and tag with manufacturer's heat or test identification number.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel reinforcing bars shall have grade identification marks and meet requirements of ASTM A 615, Grade 60 minimum. All but No. 2 bars shall be deformed type.

2.2 MANUFACTURED UNITS

A. Continuous Joint Reinforcing:
   1. Conform to ASTM A 82. Exterior wall reinforcing shall be galvanized to meet requirements of ASTM A 153, Class B-2. Interior wall reinforcing shall be galvanized to meet requirements of ASTM A 641, Class A.
   2. Size: 2 inches 50 mm less than nominal thickness of wall.
   3. Rod Size:
      a. Side rods: 9 ga 3 mm.
      b. Cross rods: 9 ga 3 mm (unless noted otherwise).
   4. Cross Rods: Cross rods that serve as metal ties in exterior cavity and other multi-wythe walls shall be drip crimped.
   5. Corners And Tee Sections: Prefabricated of material and design similar to main reinforcement.
   6. Class One Quality Standards:
      a. Multi-Wythe Masonry:
         1) Dur-O-Wal Ladur-Eye 9 ga 3 mm with 3/16 inch 5 mm diameter wire pintle with two legs where wythes do not course out together. Where wythes do course out together, use 9 ga 3 mm Dur-O-Wal Ladur Trirod.
         2) Dur-O-Wal Seismic Duro-Eye with 12 ga 4mm seismic plate pintle and with 9 ga 3 mm continuous pencil rod at veneer anchors where wythes do not course out together. Where wythes do course out together, use 9 ga 3 mm Dur-O-Wal Ladur Trirod.
      b. Single-Wythe Masonry: 9 ga 3 mm Dur-O-Wal Truss
      c. Equals by Heckman, Hohmann & Barnard, and Masonry Reinforcing Corp.

B. Rebar Positioners:
   1. Class One Quality Standards:
      a. Single Curtain: Dur-O-Wal D/A 811
      b. Double Curtain: Dur-O-Wal D/A 815
         1) Equals by Heckman, Hohmann & Barnard, and Masonry Reinforcing Corp.
   2. Equal system as approved by Architect before use. See Section 01 6200.

2.3 MANUFACTURERS

A. Contact Information:
   1. Dur-O-Wal. Div Dayton/Superior, Arlington Heights, IL www.durowal.com.
   2. Heckman Building Products Inc, Chicago, IL www.heckmannbuildingproducts.com.
   3. Hohmann & Barnard, Hauppauge, NY www.h-b.com.
   4. Masonry Reinforcing Corporation of America, Charlotte, NC www.wirebond.com.

2.4 FABRICATION

A. Fabricate and bend steel reinforcing bars according to 1988 edition of 'ACI Detailing Manual for reinforcing steel fabrication, and details on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work: Coordinate with Division 03 for placement of dowels out of foundations for masonry reinforcing.

END OF SECTION

SECTION 04 0523

MASONRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section:
   1. Mortar guard materials.

B. Related Sections:
   1. Sections under 04 2000 heading: Installation.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM B 101-02, 'Standard Specification for Lead-Coated Copper Sheet and Strips for Building Construction.'

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mortar Guard:
   1. Thickness as recommended by Manufacturer for air space.
   2. Category Four Approved Products. See Section 01 6200 for definition of Categories.
      a. The Mortar Net.
      b. Mortar Net by Hohmann & Barnard.

2.2 MANUFACTURERS

A. Contact Information:
   1. Cop-R-Kraft Duplex by Advanced Building Products Inc, Springvale, ME www.advancedflashing.com.
   2. Dur-O-Wal, Div Dayton / Superior, Arlington Heights, IL www.daytonsuperior.com.
   3. Hohmann & Barnard, Haupauge, NY www.h-b.com.
   4. Masonry Reinforcing Corporation of America, Roundtree, NC www.wirebond.com.
   5. Masonry Technology Inc, Cresco, IA www.masonrytechnology.com.
   6. The Mortar Net, Gary, IN www.mortarnet.com.
   7. Copper Kraft Duplex by Sandell Manufacturing Co, Schenectady, NY www.sandellmfg.com.
   8. Cop-R-Tex Duplex by York Manufacturing Inc, Sanford, ME www.yorkflashings.com.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 04 2223

ARCHITECTURAL CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install architectural concrete unit masonry as described in Contract Documents.
   2. Furnish and install anchor bolts and embedded anchors as described in Contract Documents.
   3. Grout door frames installed in CMU walls.

B. Products Installed But Not Supplied Under This Section:
   1. Section 05 1223: Metal Lintels.
   2. Section 07 7126: Reglets.

C. Related Sections:
   1. Section 05 0523: Quality of anchor bolts.
   2. Section 08 1213: Steel Door Frames.
   3. Section 08 5113 or 08 5313: Windows.
   4. Section 23 3714: Wall vents and louvers.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM C 90-02, 'Standard Specification for Loadbearing Concrete Masonry Units.'
   2. ASTM C 331-04, 'Standard Specification for Lightweight Aggregates for Concrete Masonry Units.'

1.3 SUBMITTALS

A. Quality Assurance / Control: Manufacturer's certification that units meet compressive strength specified requirements.

1.4 QUALITY ASSURANCE

A. Job Mock-Ups:
   1. 4 feet long by 3 feet high of proposed color range, texture, bond, mortar, and workmanship. Show wall construction to be used on Project, including reinforcing, etc.
   2. Do not start work until Architect has accepted sample panel.
   3. Use panel as standard of comparison for masonry work built of same material.

B. Pre-Installation Conference: Schedule pre-installation conference during construction of mock-up.

1.5 DELIVERY, HANDLING, AND STORAGE

A. Check, carefully unload, and deliver material to site in such a manner as to avoid soiling, damaging, or snipping.

B. Store material on planks clear of ground and protect from damage, dirt, or disfigurement.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mortar: Type 'S' mortar as specified in Section 04 0513.

2.2 MANUFACTURED UNITS

A. Concrete Masonry Units:
   1. Type 1- SMOOTH FACE - Meet requirements of ASTM C 90, Type I, moisture control units, lightweight classification.
      a. 85 lbs per cu ft minimum weight classification.
      b. Lightweight aggregates conforming to ASTM C 331.
      c. Do not use re-crushed masonry units as aggregate.
   2. Type 2- SPLIT-FACE - Meet requirements of ASTM C 90, Type I, moisture control units, lightweight classification.
      a. 85 lbs per cu ft minimum weight classification.
      b. Lightweight aggregates conforming to ASTM C 331.
      c. Do not use re-crushed masonry units as aggregate.
   3. Type 3- INTEGRAL COLORED HONED FACE - Meet requirements of ASTM C 90, Type I, moisture control units, lightweight classification.
      a. 85 lbs per cu ft minimum weight classification.
      b. Lightweight aggregates conforming to ASTM C 331.
      c. Do not use re-crushed masonry units as aggregate.
   4. Outside Corners: Square-edged, except where bull nose is indicated on Drawings.
   5. Use special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, etc, as required.
   6. Uniform color and textures with unbroken edges. Smooth face, except where shown otherwise on Drawings.

2.3 ACCESSORIES

A. Construction Cleaning Compounds:
   1. Type Two Acceptable Products:
      a. 202 or 202V by Diedrich Technologies, Oak Creek, WI www.diedrichtechnologies.com.
      b. Surekleen No. 600 or Vana-Trol by ProSoCo Inc, Kansas City, KS www.prosoco.com.
      c. Equal as approved by Architect before use. See Section 01 6000.
      d. Zonolite by Grace Construction Products, Cambridge, MA www.na.graceconstruction.com.
      e. Equal as approved by Architect before use. See Section 01 6000.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Site Tolerances:
   1. Masonry work shall be true to vertical and horizontal planes within 1/8 inch in 10 feet, non-cumulative.
   2. Maintain 3/8 inch mortar joints throughout.

B. General:
   1. Make cuts proper size to accommodate work of other trades. Cut openings for electrical devices using cover plates no larger than can be covered by standard size plate. Replace unit masonry in which larger than necessary openings are cut. Do not patch openings with mortar or other material.

2. Step back unfinished work for joining with new work. Use toothing only with Architect's approval.

C. Laying:
1. Layout:
   a. Running bond except where indicated otherwise. Select brick so there is uniform distribution of hues.
   b. Use solid brick where brick coursing would otherwise show cores.
2. Joints:
   a. Tool concave. Fill completely except where indicated differently.
   b. Do not tool until mortar has taken initial set.
   c. Point holes in joints. Fill and tool properly.
3. Concrete Masonry Units:
   a. Lay hollow masonry units dry. Do not lay masonry on frozen material.
   b. Align cells or cavities to preserve an unobstructed cavity for grouting.
   c. Full bedding required on both webs and face shell under first course. Other courses need only face shell bedding except where bedding is needed to control the flow of grout. Do not allow excess mortar to block cells receiving grout or foamed-in-place insulation.

D. Reinforcing:
1. Reinforcing shall be free of material that may destroy bond.
2. Masonry Reinforcing Steel:
   a. Place steel as shown on Drawings.
   b. Hold vertical reinforcing in place every 32 inches.
   c. Splice 48 bar diameters minimum.
   d. Place reinforcing and dowels before pouring grout.
   e. Dowel vertical reinforcing bars out of structure below with bars of same size and spacing.
   f. Place horizontal bars in 8 inch deep bond beam units at top of wall and at 48 inches on center between. Continue bond beam units and reinforcement uninterrupted around corners and across wall intersections.
   g. Place special vertical bars of same size as normal vertical reinforcement at corners and jambs of openings and recesses where bond beams are interrupted and at beam bearing locations not otherwise detailed.
   h. Unless detailed otherwise, place special horizontal bars of same size as normal reinforcing above and below openings. Extend bars 24 inches minimum beyond opening.

E. Grouting:
1. CMU cells:
   a. Fully grout cells as shown on drawings, or if not specified, as follows:
      1) Cells containing reinforcing bars.
      2) All cells in concrete block foundations.
      3) All cells where sound control requirements are indicated.
      4) Bond beams and lintel blocks.
      5) Other cells indicated on Drawings to be fully grouted.
   b. Place grout in 48 inch maximum lifts.
   c. Consolidate grout by means of a mechanical vibrator. Do not use cell reinforcing to rod grout.
   d. Before loss of plasticity, mechanically reconsolidate grout.
2. Grout hollow metal door frames solid.
3. Provide grout-leveling bed for support of wall plates.

3.2 CLEANING

A. After mortar has hardened, wet masonry and clean with specified cleaning compound. Use stiff fibered brush for application. Rinse masonry surfaces with water immediately after cleaning. Leave masonry clean, free of mortar daubs, and with tight mortar joints.

B. Remove and replace defective material at Architect's direction and at no additional cost to Owner.

C. Clean up masonry debris and remove from site.

3.3 PROTECTION

A. Protect masonry at all times with cover during wet, rainy, or snowy weather.

B. Cover work at end of each workday with tarpaulins if temperature is 25 to 40 deg F. If temperature is below 25 deg F, protect with heaters. Maintain temperature around masonry to 40 deg F minimum for 48 hrs if Type I, 24 hrs if Type III, or longer if required.

C. Brace masonry walls until walls attain adequate strength and are tied into building structure.

D. Do not allow structural loading of masonry walls until walls attain adequate strength.

END OF SECTION

DIVISION 05: METALS

05 0000 METALS

05 0503 SHOP APPLIED METAL COATINGS
05 0523 METAL FASTENINGS

05 1000 STRUCTURAL METAL FRAMING

05 1223 STRUCTURAL STEEL FOR BUILDINGS

05 3000 METAL DECKING

05 3123 STEEL ROOF DECKING
05 3133 STEEL FORM DECKING

05 5000 METAL FABRICATIONS

05 5113 METAL STAIRS
05 5133 METAL LADDERS
05 5136 CATWALKS
05 5214 GALVANIZED STEEL PIPE AND TUBE RAILINGS
05 5215 STAINLESS STEEL CORNER GUARDS
05 5871 METAL BRACKETS

END OF TABLE OF CONTENTS

SECTION 05 0503

SHOP-APPLIED METAL COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of factory or shop-applied priming applied to steel supplied to Project without finish coat.
   2. Quality of and procedures for field touch-up and repair of factory-applied priming and galvanizing.

B. Related Requirements:
   1. Sections under 09 9000 heading: Finish painting.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A 780-01, 'Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.'
      b. ASTM B 695-04, 'Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.'

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Meet with Architect before commencing repair of galvanized surfaces to establish extent of repairs required and, if applicable, choice of methods to be used.

1.4 SUBMITTALS

A. Action Submittals:
   1. Product Data: Product data and samples, if requested by Architect.

PART 2 - PRODUCTS

2.1 FINISHES

A. Factory And Shop-Applied Primer: Compatible with and of equal or better quality than finish paint system to be applied by Sections under 09 9000 heading. Primer on unexposed, unfinished surfaces may be fabricator's standard shop coat.

B. Repairs To Primed Surface: Unless otherwise specified, use primer which matches characteristics of original primer and is compatible with and of equal or better quality than finish paint system to be applied by Sections under 09 9000 heading.

C. Material For Repairs Of Galvanized Surfaces:
   1. Non-Structural, Non-Load-Bearing Items Not Exposed To Weather:
      a. Zinc-Rich Paints:
         1) Zinc-Dust Content: Dried film shall contain 94 percent minimum of zinc-dust by weight.
         2) Type One Acceptable Manufacturers:
            a) Galvax by Alvin Products Inc, Everett, MA www.alvinproducts.com.

b) ZRC Galvilite by ZRC Worldwide, Marshfield, MA www.zrcworldwide.com.
c) Equal as approved by Architect before bidding. See Section 01 6200.

2. Structural, Load-Bearing Items And Items Exposed To Weather:
   a. Zinc-Based Solders, Powder, Or Rod:
      1) Zinc-Cadmium solder with liquidus temperature range from 518 to 527 deg F, or
      2) Zinc-Tin-Lead alloy with liquidus temperature range from 446 to 500 deg F.
   b. Sprayed Zinc: Wire, ribbon, or powdered zinc suitable for process.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:
   1. Clean, grind, or otherwise prepare welds in steel that is to be coated within limits acceptable to welder responsible for structural integrity.
   2. Surfaces to be coated shall be clean, dry and free of oil, grease, and corrosion products.

B. Preparation Of Primed, Ungalvanized Surfaces: Clean welds and grind serious abrasions.

C. Preparation Of Galvanized Surfaces:
   1. Follow requirements of ASTM A 780 and following:
   2. For Repair Using Zinc-Rich Paints:
      a. Blast clean surfaces to near-white metal, in accordance with SSPC-SP10 (1 to 2 mil anchor pattern), as minimum.
      b. Where circumstances do not allow blast cleaning, power disk sand to bright metal finish.
      c. Extend surface preparation into undamaged galvanized area.
      d. Remove flux residue and weld spatter from welded areas.
   3. For Repair Using Zinc-Based Alloys:
      a. Clean surface to be reconditioned using wire brush, light grinding action, or mild blasting.
      b. Extend surface preparation into surrounding, undamaged galvanized areas.
      c. Remove flux residue and weld spatter from welded areas.
      d. Preheat cleaned area to at least 600 deg F.
         1) Do not overheat surface beyond 750 deg F or allow surrounding galvanized coatings to be burned.
         2) Wire brush surface during preheating.
   4. For Repair Using Sprayed Zinc (Metallizing):
      a. Blast clean surfaces to near-white metal, in accordance with SSPC-SP5 as minimum.
      b. Extend surface preparation into undamaged galvanized area.
      c. Remove flux residue and weld spatter from welded areas.

3.2 REPAIR / RESTORATION

A. Repairs To Primed, Ungalvanized Surfaces:
   1. Thoroughly clean metal and give one prime coat of specified material, well-worked into metal joints and open spaces. Match existing primed finish as required.
      a. Do not apply primer at temperatures below 45 deg F.
      b. Protect un-primed machine-finished surfaces against corrosion by priming.

B. Repairs To Galvanized Surfaces:
   1. Non-Structural, Non-Load-Bearing Items Not Exposed To Weather:
      a. Repair Using Zinc-Rich Paints: Spray- or brush-apply zinc-rich paint to prepared area. Apply paint in single application employing multiple spray passes to achieve dry film thickness of 2 mils.
   2. Structural, Load-Bearing Items And Items Exposed To Weather:
      a. Repair Using Zinc-Based Alloys:

1) Rub cleaned, pre-heated areas with repair stick to deposit evenly distributed layer of zinc alloy. If powdered zinc alloys are used, sprinkle powder on surface and spread out with spatula or similar tool.
2) Remove flux residue by rinsing with water or wiping with damp cloth.

b. Repair Using Sprayed Zinc (Metallizing): Apply 2 mil minimum coating by means of metal-spraying pistols fed with either zinc wire or zinc powder in accordance with requirements of ASTM B 695, Type I.

3. All Items:
   a. Apply repair materials immediately after surface preparation is complete.
   b. Take thickness measurements, with either magnetic or electromagnetic gauge, to ensure applied coating is as specified or agreed to.

END OF SECTION

SECTION 05 0523

METAL FASTENING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of structural metal-to-metal, wood-to-metal, and wood-to-wood bolts used on Project.
   2. Requirements and standards for site welded metal-to-metal connections.

B. Related Requirements:
   1. Section 03 1511: Cast-in-place and drilled-in anchor bolts.
   2. Furnishing and installing of structural bolts specified under Section concerned.
   3. Performance of welding specified under Section concerned.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A 36-05, 'Standard Specification for Carbon Structural Steel.'
      b. ASTM A 307-04, ‘Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.’
      c. ASTM A 325-02, 'Standard Specification for High-Strength Bolts for Structural Steel Joints.'
   2. American Welding Society / American National Standards Institute:
      a. AWS / ANSI D1.1-2003, 'Structural Welding Code - Steel.'
      b. AWS / ANSI D1.3-1998, 'Structural Welding Code - Sheet Steel.'

1.3 QUALITY ASSURANCE

A. Qualifications: Welders shall be certified 30 days minimum before beginning work on Project. If there is doubt as to proficiency of welder, Architect may require welder to take another test, at no expense to Owner. Certification shall be by Pittsburgh Laboratories or other authority approved by Architect.

B. Certifications: Maintain welder's certifications on job-site.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Materials:
   1. Bolts And Threaded Fasteners:
      a. Anchor Rods For Steeple Base Connections: Conform to requirements of ASTM A 36.
      b. Bolts: Conform to requirements of ASTM A 307, Grade A.

2.2 ACCESSORY PRODUCTS

A. Arc-Welding Electrodes: Type E70XX AWS Iron and Steel Arc-welding electrodes and meeting current AISC Specifications.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Welding shall meet requirements of ANSI / AWS D1.1 and D1.3.

B. Minimum weld sizes, unless detailed otherwise.
   1. Weld pipe columns to base plates and top plates with 1/4 inch fillet weld all around.
   2. Weld glu-lam connection side plates to base plates with 1/4 inch fillet weld all along outside edges.
   3. Weld stiffeners to pipe columns with 1/4 inch fillet weld all around.

END OF SECTION

SECTION 05 1223

STRUCTURAL STEEL FOR BUILDINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:
   1. Miscellaneous structural steel.
   2. Lintels.
   3. Structural pipe for bollards.

B. Related Requirements:
   1. Section 03 3053: Installation of bollards and satellite dish base.
   2. Sections under 04 2000 heading: Installation of lintels and miscellaneous structural steel.
   3. Section 05 0503: Quality of priming.
   4. Section 05 0523: Quality of welding.
   5. Section 06 1100: Installation of miscellaneous structural steel.

1.2 REFERENCES

A. Reference Standards:
   1. American Society For Testing And Materials:
      a. ASTM A 36-05, 'Standard Specification for Carbon Structural Steel.'
      b. ASTM A 53-05, 'Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.'
      c. ASTM A 500-03a, 'Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.'

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Materials:
   1. Lintels, Channel Frames, And Miscellaneous Structural Steel: Meet requirements of ASTM A 36.
   2. Structural Pipe.
      a. Meet requirements of ASTM A 53, Type E or S, Grade B.
         1) Weight Class, STD, Schedule 40.
         2) Weight Class, XS, Schedule 80.
         3) Weight Class, DXS.
   3. Structural Tubing: Meet requirements of ASTM A 500, Grade B.

B. Fabrication:
   1. After fabrication and before shop priming, hot-dip or mechanically galvanize lintels to be installed in exterior walls, and bollards.
   2. Shop prime steel provided under this Section.

C. Finishes:
   1. Shop Primer:
      a. Concealed Steel: Fabricator's standard shop coat.
      b. Exposed Steel To Receive Finish: Primer shall be acceptable to Finish Manufacturer.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 05 3123

STEEL ROOF DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install steel roof decking as described in Contract Documents.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM A 653-02a, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.'

PART 2 - PRODUCTS

2.1 MATERIALS

A. Roof Deck:
   1. 22 gauge composite intermediate rib deck formed from flat rolled carbon steel sheets meeting requirements of ASTM A 653, Grade A, zinc coated.
   2. Product Standard: 1-1/2 inch, USD, B-Deck.
   3. Type One Acceptable Manufacturers:
      a. Any current member of the Steel Deck Institute.
      b. Equal as approved by Architect before bidding. See Section 01 6000.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with American Iron & Steel Institute's 'Specification for the Design of Cold-Formed Steel Structural Members,' Section 4.2.1.

B. Install by welding.

END OF SECTION

SECTION 05 3133

STEEL FORM DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install complete non-composite steel form decking as described in Contract Documents.
   2. Furnish and install steel piercing hanger tabs as described in Contract Documents.

B. Related Sections:
   1. Section 03 3111: Normal Weight Structural Concrete.
   2. Section 05 0523: Quality of Welding.
   3. Section 05 1223: Miscellaneous Structural Steel.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM A 1008-03, 'Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.'

B. American Welding Society / American National Standard Institute:
   1. AWS / ANSI D1.3-1998, 'Structural Welding Code - Sheet Steel.'

C. Steel Deck Institute:
   1. SDI 29, 'Steel Deck Institute Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution.'

1.3 SUBMITTALS

A. Product Data: Provide Manufacturer's cut sheets including, but not limited to, dimensions of individual components, profiles, and finishes.

B. Shop Drawings: Show location of metal deck panels, anchorage details, and other information required for thorough review.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect metal deck panels from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Storage:
   1. If ground storage is required, store bundles of metal deck panels off ground with one end elevated to provide drainage.
   2. Protect bundles from condensation with ventilated waterproof covering.
   3. Stack bundles to prevent material damage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Roof Deck:
   1. Non-composite steel deck formed from steel sheets meeting requirements of ASTM A 1008 with minimum yield strength 33 ksi 230 Mpa.
   2. Provide multi-span deck.
   3. Type One Acceptable Products:
      a. Any current member of Steel Deck Institute.
      b. Equal as approved by Architect before bidding. See Section 01 6000.

2.2 ACCESSORIES

A. Pour stops, column closures, end closures, cover plates, and girder fillers of types required by SDI.

B. Piercing Hanger Tabs:
   1. Minimum Allowable Load: 250 lb 1.1 kN per tab.
   2. Pull out resistance greater than 1400 lbs 6.23 kN in 3400 psi 23.4 Mpa concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine support framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work of this Section.

3.2 PREPARATION

A. Do not place deck panels on concrete support structure until concrete has been fully cured and is dry.

B. Locate bundles to prevent overloading of support members.

3.3 INSTALLATION

A. Deck:
   1. Each deck piece shall span across minimum of two spans.
   2. Install in accordance with SDI specifications and recommendations, as shown on placement drawings, and as specified.
   3. Place deck panels on structural supports and adjust to final position with ends aligned. Attach firmly to supports immediately after placement.
   4. Cut and neatly fit deck units and accessories around openings and other work projecting through or adjacent to decking.
   5. Do not cut unscheduled openings through deck without approval of Architect. Reinforce openings as shown on Drawings or as directed by Architect.
   6. Anchor deck units to steel supporting members by arc spot puddle welds of 5/8 inch 15 mm minimum visible diameter welds with weld pattern shown on Drawings.
   7. Install deck ends over supports with minimum end bearing 1-1/2 inches 38 mm.
   8. Fasten pour stops and girder fillers to supporting structure according to Manufacturer's written recommendations and as shown on Drawings.
   9. Fasten column closures and cell closures to provide tight fitting closures at open ends of ribs and sides of decking.

B. Piercing Hanger Tabs: Install tabs at 48 inches 1 200 mm on center in each direction as scheduled on Drawings.

3.4 ADJUSTING

A. Before concrete placement, inspect metal deck for tears, dents, or other damage that may prevent deck from performing as tight and substantial form. Repair or replace damaged metal deck panels as required at no additional cost to Owner.

END OF SECTION

SECTION 05 5113

METAL STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install steel stairs complete with metal grate landing, hand rails and guard rails as described in Contract Documents.
   2. Furnish and install stringers, risers, and metal pans to receive concrete treads on interior stairs as described in Contract Documents.

B. Related Sections:
   1. Section 03 3111: Normal weight structural concrete.
   2. Section 05 0503: Quality of Priming and repair of galvanizing
   3. Section 05 0523: Quality of Welding.
   4. Section 09 9113: Painting of Interior Metal.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM A 36-03a 'Standard Specification for Carbon Structural Steel.'
   2. ASTM A 53-02, 'Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.'
   3. ASTM A 501-01, 'Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.'
   4. ASTM A 1011-03a, 'Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.'

1.3 SUBMITTALS

A. Shop Drawings: Furnish for approval before fabrication.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Materials: Stringers: Galvanized steel meeting requirements of ASTM A 36.

B. Tread Pans And Landing Plates: Minimum 14 ga formed galvanized sheet steel meeting requirements of ASTM A 1011.

C. Header Channels: Minimum C6 x 8.2 galvanized steel channels meeting requirements of ASTM A 36.

D. Pipe For Handrails And Balusters: 1-1/2 inch outside diameter galvanized steel pipe, meeting requirements of ASTM A 53 or galvanized steel tubing meeting requirements of ASTM A 501.

E. Pipe Sleeves: 2 inch diameter by 6 inch to 9 inch long galvanized standard round pipe.

F. Acceptable Manufacturer:

1. Manufacturer shall be AISC certified.

2.2 FINISHES

A. Shop prime components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install using appropriate anchors and attachments.

END OF SECTION

SECTION 05 5133

METAL LADDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section:
   1. Metal Ladders.

B. Related Sections:
   1. Section 05 0503: Quality of priming and repair of galvanizing.
   2. Section 05 0523: Quality of welding.
   3. Section 06 2001: Installation.
   4. Section 09 9113: Painting of interior ladders.

1.2 REFERENCES

A. American Ladder Institute / American National Standards Institute:
   1. ALI / ANSI A 14.3-2000,'Ladders - Fixed - Safety Requirements.'

B. American Society For Testing And Materials:
   1. ASTM A 36-03a, 'Specification for Carbon Structural Steel.'

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel For Interior Ladders: Galvanized - meet requirements of ASTM A 36.

2.2 COMPONENTS

A. Stringers: 3/8 by 3-1/2 inch by 2-1/2 inch galvanized angle.

B. Treads: One inch galvanized round rungs.

C. Mounting Brackets: Galvanized drilled angles.

2.3 FABRICATION

A. Fabricate ladders to comply with requirements of ALI / ANSI A 14.3.

B. Weld joints. Grind joints to be smooth to the touch and finished to match adjoining surfaces.

C. Space treads 12 inches on centers.

D. Fabricate mounting brackets of drilled angles.

E. Prime interior ladders.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Support ladder with welded steel brackets located at top and bottom. At top weld to steel beam, at bottom bolt through bracket to concrete floor slab. Size brackets to support design loads specified in ALI / ANSI A 14.3.

END OF SECTION

SECTION 05 5136

CATWALKS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install catwalks as described in Contract Documents.

1.2 REFERENCES

A. American Society for Testing Materials:
   1. ASTM A 36-00, 'Standard Specification for Carbon Structural Steel.'

1.3 SUBMITTALS

A. Shop Drawings: Shop drawings and calculations for catwalks, prepared and stamped by licensed engineer experienced in similar construction showing connections and anchoring system.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Shapes And Angles:
   1. Meet requirements of ASTM A 36.
   2. Structural steel hanger rods, railings, metal grating together with structural framing.
   3. Galvanized metal.

PART 3 - EXECUTION

3.1 FINISHING

A. Finish with shop applied powder coating. Colors per OSHA requirements.

END OF SECTION

SECTION 05 5214

GALVANIZED STEEL PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install galvanized steel pipe handrails as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:
   1. Anchoring sleeves in concrete (if used).

C. Related Requirements:
   1. Section 03 3111: Installation of anchoring sleeves.
   2. Section 05 0503: Quality of priming and repair of galvanizing.
   3. Section 05 0523: Quality of welding.
   4. Finish painting:
      a. Exterior & interior: Section 09 9113.
   5. Section 10 2813: Grab bars in Rest Rooms.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A 36-05, 'Standard Specification for Carbon Structural Steel.'
      b. ASTM A 53-05, 'Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.'
      c. ASTM A 123-02, 'Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.'
      d. ASTM A 501-01, 'Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.'
      e. ASTM C 1107-05, 'Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).'

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings: Show fabrication and installation of handrails and railings including floor plans, elevations, sections, details of components, and attachments to other elements of The Work.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:
   1. Store handrails and railing systems in clean, dry location, away from uncured concrete and masonry, and protected against damage.
   2. Cover with waterproof paper, tarpaulin, or polyethylene sheeting. Allow for air circulation inside covering.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Materials:
   1. Handrails, Railings, And Balusters: Galvanized steel pipe meeting requirements of ASTM A 53 or galvanized steel tubing meeting requirements of ASTM A 501.
   2. Sleeves:
      a. 6 to 9 inches long with cross-section shape and dimension to allow 1/2 inch minimum of grout around perimeter of pipe or tube.
      b. Provide with fully welded steel plate forming bottom closure.
   3. Brackets, Flanges, Fittings, And Anchors:
      a. Provide standard wall brackets, flanges, miscellaneous fittings, and anchors for connection of handrails and railings to other construction.
      b. Provide inserts and other anchorage devices for connecting handrails and railing systems to concrete or masonry work.

B. Fabrication:
   1. Preassemble railing systems in shop to greatest extent possible to minimize field splicing and assembly.
   2. 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.
   3. Grind smooth welded joints and buff welds to same appearance as remainder of railing. Repair galvanizing and cut pipe ends as specified in Section 05 0503.
   4. Form curves by bending pipe in jigs to produce uniform curvature for each configuration required. Maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
   5. Welded Connections:
      a. Fabricate railing system and handrail connections by welding.
      b. Weld corners and seams continuously to comply with following:
         1) Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
         2) At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.
         3) At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and so contours of welded surfaces match adjacent surfaces.
   6. Return pipe ends of wall mounted handrails into wall.
   7. Cap pipe ends of floor / ground mounted handrails and exterior handrails.
   8. After fabrication, shop prime metal to be painted.

C. Finishes:
   1. Factory-applied powder-coated finish. Color as selected by Architect from Manufacturer's standard colors.

2.2 ACCESSORY PRODUCTS

A. Rail Setting Grout:
   1. Commercial nonshrink grout conforming to requirements of ASTM C 1107, Type B or Type C.
   2. Type Three Approved Manufacturers:
      a. Normal Construction Grout A by Bonsal American, Charlotte, NC www.bonsal.com.
      b. Advantage 1107 Grout by Dayton Superior Specialty Chemicals, Kansas City, KS www.daytonsuperiorchemical.com.
      c. NS Grout by Euclid Chemical Co, Cleveland, OH www.euclidchemical.com
      d. 5 Star Special Grout 110 by Five Star Products Inc, Fairfield, CT www.fivestarproducts.com.
      e. Duragrout by L&M Construction Chemicals Inc, Omaha, NE www.lmcc.com

f. Sonneborn / BASF Building Systems, Shakopee, MN www.chemrex.com.
g. Tamms Grout 621 by TAMMS Industries, Mentor, OH www.tamms.com.
h. U S Spec MP Grout by U S Mix Products Co www.usspec.com.
i. CG-86 Grout by W R Meadows, Hampshire, IL www.wrmeadows.com.
j. Equal as approved by Architect before use. See Section 01 6200.

END OF SECTION

SECTION 05 5215

STAINLESS STEEL CORNER GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install stainless steel corner guards as described in Contract Documents.

B. Products Supplied But Not Installed Under This Section:
   1. na

1.2 SUBMITTALS

A. Shop Drawings: Show fabrication and installation of handrails and railings including floor plans, elevations, sections, details of components, and attachments to other elements of The Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Corner Guards: 16 gauge non-magnetic stainless steel.

2.2 FABRICATION

A. General:
   1. 2 inch be 2 inch by 96 inches long.
   2. Bend 90 degrees
   3. 5 degree kink at each outside edge.
   4. Grind smooth and buff edges.

B. Welded Connections:
   1. Fabricate railing system and handrail connections by welding.
   2. Weld corners and seams continuously to comply with following:
      a. Use materials and methods that minimize distortion and develop of metals.
      b. At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.
      c. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and so contours of welded surfaces match adjacent surfaces.

2.3 MANUFACTURERES

A. Design Standard:
   1. Kingdon Sheet Metal. (801) 262-4412.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Attach with construction adhesive.

END OF SECTION

SECTION 05 5871

METAL BRACKETS

PART 1 - GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section:
   1. Metal brackets necessary to support vanities in Rest Rooms.

B. Related Requirements:
   1. Section 05 0503: Quality of priming.
   2. Section 05 0523: Quality of welding.
   3. Section 06 2001: Installation.
   4. Section 09 9124: Finish painting.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A 36-05, 'Standard Specification for Carbon Structural Steel.'

PART 2 - PRODUCTS

2.1 FABRICATED UNITS

A. Materials:
   1. Steel: Meet requirements of ASTM A 36.

B. Fabrication:
   1. Fabricate as detailed.
   2. Grind exposed welds smooth and polish to match non-welded metal finish.
   3. After fabrication and drilling of mounting holes, shop prime.

PART 3 - EXECUTION: Not Used

END OF SECTION

DIVISION 06: WOOD, PLASTICS, AND COMPOSITES

06 0000 WOOD, PLASTICS, AND COMPOSITES

06 0573 PRESERVATIVE WOOD TREATMENT

06 1000 ROUGH CARPENTRY

06 1011 WOOD FASTENINGS
06 1100 WOOD FRAMING

06 2000 FINISH CARPENTRY

06 2001 COMMON FINISH CARPENTRY REQUIREMENTS
06 2024 DOOR, FRAME, AND FINISH HARDWARE INSTALLATION

06 4000 ARCHITECTURAL WOODWORK

06 4001 COMMON ARCHITECTURAL WOODWORK REQUIREMENTS
06 4005 PLASTIC LAMINATE
06 4110 CUSTOM CASEWORK

06 6000 PLASTIC FABRICATIONS

06 6413 PLASTIC PANELING

END OF TABLE OF CONTENTS

SECTION 06 0573

PRESERVATIVE WOOD TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of wood preservative treatment where specified.

B. Related Sections:
   1. Section 06 1100:
      a. Characteristics of wood to be pressure-treated.
      b. Furnishing and installing of pressure-treated wood.

1.2 REFERENCES

A. American Wood-Preserver's Association:
   1. AWPA C1-96, 'All Timber Products, Pressure Treatment.'
   2. AWPA C2-96, 'Lumber, Timbers, Bridge Ties and Mine Ties, Pressure Treatment.'
   3. AWPA C31-xx, 'Lumber Used Out of Contact with the Ground and Continuously Protected from Liquid Water.'
   4. AWPA C33-xx, 'Standard for Preservative Treatment of Structural Composite Lumber by Pressure Processes.'
   5. AWPA P5-xx. 'Waterborne Preservatives.'
   6. AWPA N1-96. 'All Millwork, Preservative Treatment by Non-Pressure Process.'

1.3 SUBMITTALS

A. Quality Assurance / Control: Certificate of pressure treatment showing compliance with specification requirements and including information required under IBC Section 2303.1.8.1.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pressure Treatment Of Wood:
   1. Framing lumber grade and species shall be as specified in Section 06 1100 for particular use.
   2. Interior Wood In Contact With Concrete or Masonry:
      a. Preservatives:
         1) Disodium octoborate tetrahydrate (DOT / SBX) meeting requirements of AWPA C31 and with retention of 0.25 lbs per cu ft.
         2) Zinc borate meeting requirements of AWPA C33 and with retention of 0.17 lbs per cu ft.
      b. Lumber: Treat in accordance with AWPA C31 or C33 and dry after treatment.
      c. Millwork: Treat in accordance with AWPA N1 and dry after treatment.
   3. Exterior Wood Continuously Exposed To Weather:
      a. Preservatives: Waterborne preservatives meeting requirements of AWPA C2 with retention levels as required by AWPA C2 for specific application.
      b. Lumber: Treat in accordance with AWPA C2 and dry after treatment.

B. Type One Acceptable Manufacturers:
   1. Arch Wood Protection Inc, Smyrna, GA www.wolmanizedwood.com.
   2. Chemical Specialties Inc, Charlotte, NC www.treatedwood.com.
   3. Hoover Treated Wood Products, Thomson, GA www.frtw.com.
   4. Osmose Inc, Griffin, GA www.osmose.com.
   5. U S Borax Inc, Valencia, CA www.borax.com/wood.
   6. Equal as approved by Architect before bidding. See Section 01 6200.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 06 1011

WOOD FASTENINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of wood fastening methods and materials unless specified otherwise.

B. Related Sections:
   1. Section 05 0523: Quality of bolts used on Project.
   2. Furnishing and installing of fasteners specified in individual Sections where installed.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM F 1667-02a, 'Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.'

1.3 DEFINITIONS

A. Nail Terminology:
   1. When following nail terms are used in relation to this Project, following lengths and diameters will be understood. Refer to nails of other dimensions by actual length and diameter, not by one of listed terms:

Nail Term	Length	Diameter	Length	Diameter
8d Box	2-1/2 inches	0.113 inch	63.5 mm	2.827 mm
8d Common	2-1/2 inches	0.131 inch	63.5 mm	3.389 mm
10d Box	3 inches	0.128 inch	76.2 mm	3.251 mm
10d Common	3 inches	0.148 inch	76.2 mm	3.759 mm
16d Box	3-1/2 inches	0.135 inch	88.9 mm	3.411 mm
16d Sinker	3-1/4 inches	0.148 inch	82.6 mm	3.759 mm
16d Common	3-1/2 inches	0.162 inch	88.9 mm	4.115 mm

1.4 SUBMITTALS

A. Shop Drawings:
   1. Submit diameter and lengths of fasteners proposed for use on Project. If length or diameter of proposed fasteners differ from specified fasteners, also include technical and engineering data for proposed fasteners including, but not limited to:
      a. Adjusted fastener spacing where using proposed fasteners and,
      b. Adjusted number of fasteners necessary to provide connection capacity equivalent to specified fasteners.
   2. Submit on powder-actuated fasteners other than those specified in Contract Documents showing design criteria equivalents at each application.
   3. Show type, quantity, and installation location of framing anchors. Where necessary, reference Drawing details, etc, for installation locations.

B. Quality Assurance / Control: Manufacturer's literature on framing anchors and powder actuated fasteners.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fasteners:
1. Fasteners in contact with preservative treated wood shall be hot-dipped galvanized or G-185 coated.
2. Nails:
   a. Meet requirements of ASTM F 1667.
   b. Unless noted otherwise, nails listed on Drawings or in Specifications shall be common nail diameter, except 16d nails, which shall be box diameter.
3. Wood Screws: Standard type and make for job requirements.
4. Powder-Actuated Fasteners:
   a. Class Two Quality Standard: Hilti X-DNI 62P8.
   b. Manufacturers:
      1) Hilti, Tulsa, OK www.hilti.com.
      2) Ramset / Redhead Division of ITW, Wood Dale, IL www.ramset-redhead.com and Markham, ON www.itwconstruction.ca.
      3) Equals as approved by Architect through shop drawing submittal before installation. See Section 01 6000.
5. Expansion Bolts:
   a. Type Two Acceptable Products:
      1) Kwik Bolt 3 by Hilti, Tulsa, OK www.hilti.com.
      2) Trubolt by Ramset / Redhead Division of ITW, Wood Dale, IL www.ramset-redhead.com and Markham, ON www.itwconstruction.ca.
      3) Equals as approved by Architect through shop drawing submittal before installation. See Section 01 6000.
6. Screw Anchors:
   a. Type Two Acceptable Products:
      1) HUS-H Screw Anchor by Hilti, Tulsa, OK www.hilti.com.
      2) Titen HD by Simpson Strong Tie Co, Dublin, CA www.strongtie.com.
      3) Equals as approved by Architect through shop drawing submittal before installation. See Section 01 6000.

B. Adhesives:
1. Construction Mastics: Meet requirements of American Plywood Association Specification AFG-01 September 1974. Use phenol-resorcinol type for use on pressure treated wood products.

C. Framing Anchors:
1. Framing anchors and associated fasteners in contact with preservative treated wood shall be hot-dipped galvanized, G-185 coated, or stainless steel. However, do not use stainless steel items with galvanized items.
2. Type Two Acceptable Products:
   a. Advanced Connector Systems (ACS), Tempe, AZ www.acsboss.com.
   b. KC Metals Inc, San Jose, CA www.kcmetals.com.
   c. Simpson Strong Tie Co, Dublin, CA www.strongtie.com.
   d. United Steel Products Co Inc (USP), Montgomery, MN www.uspconnectors.com.
   e. Equals as approved by Architect through shop drawing submittal before installation. See Section 01 6000.

PART 3 - EXECUTION

3.1 ERECTION

A. Secure one Manufacturer approved fastener in each hole of framing anchor that bears on framing member unless approved otherwise in writing by Architect. 'Boss' system by ACS is acceptable nailing system for framing anchors.

B. Provide bolt heads and nuts bearing on wood with washers.

END OF SECTION

SECTION 06 1100

WOOD FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install wood framing and blocking as described in Contract Documents.

B. Products Installed But Not Supplied Under This Section:
   1. Miscellaneous structural steel elements.
   2. Wall Plates & Blocking

C. Related Sections:
   1. Section 05 1223: Furnishing of miscellaneous structural steel.
   2. Section 06 0573: Quality of Preservative Wood Treatment.

1.2 REFERENCES

1. NA

1.3 SUBMITTALS

A. Quality Assurance / Control:
   1. Technical and engineering data on nails to be set by nailing guns for Architect's approval of types proposed to be used as equivalents to specified hand set nails and adjusted number and spacing of pneumatically-driven nails to provide equivalent connection capacity.

1.4 QUALITY ASSURANCE

A. Pre-Installation Conference:
   a. Not required.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect lumber and plywood and keep under cover in transit and at job site.

B. Do not deliver material unduly long before it is required.

C. Store lumber and plywood on level racks and keep free of ground to avoid warping. Stack to insure proper ventilation and drainage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Dimension Lumber:
   1. Meet requirements of PS 20 and National Grading Rules for softwood dimension lumber.
   2. Bear grade stamp of WWPA, SPIB, or other association recognized by American Lumber Standards Committee identifying species of lumber by grade mark or by Certificate of Inspection.
   3. Identify lumber and plywood by grade mark or Certificate of Inspection issued by approved lumber grading or inspection bureau or agency. Graded American lumber may be used, subject to CLSAB approval.
   4. Lumber 2 inches or less in nominal thickness shall not exceed 19 percent in moisture content at time of fabrication and installation and be stamped 'S-DRY', 'K-D', or 'MC15.'
   5. Lumber shall be S4S.
   6. Preservative Treated Plates / Sills:
      a. 2x4: Standard and better Douglas Fir, Southern Pine, or HemFir, or StrandGuard by Trus Joist, Boise, ID www.tjm.com.
      b. 2x6 And Wider: No. 2 or or MSR 1650f - 1.5e Douglas Fir, Southern Pine, HemFir, or StrandGuard by Trus Joist, Boise, ID www.trusjoist.com.

B. Plates & Blocking: Sound lumber without splits, warps, wane, loose knots, or knots larger than 1/2 inch.

C. Furring Strips: Utility or better.

PART 3 - EXECUTION

3.1 ERECTION

A. General: Use preservative treated wood for wood members in contact with concrete or masonry, including wall, sill, and ledger plates, door and window subframes and bucks, etc.

B. Interface With Other Work:
   1. Coordinate with other Sections for location of blocking required for installation of equipment and building specialties. Do not allow installation of gypsum board until required blocking is in place.
   2. Where manufactured items are to be installed in framing, provide rough openings of dimensions within tolerances required by manufacturers of such items. Confirm dimensions where not shown on Drawings.
   3. Sill Plates:
      a. Shear Walls And Bearing Walls:
         1) Provide specified anchor 12 inches maximum and 4 inches minimum from each end of each plate.
      b. Install specified seal sealer under sill plates of exterior walls of main building and of acoustically insulated interior walls.
   4. Nailing:
      a. Top plates: Spiked together, 16d, 16 inches on center.
      b. Top plates: Laps, lap members 48 inches minimum and nail with 16d nails 4 inches on center
      c. Top plates: Intersections, three 16d.
      d. Backing And Blocking: Three 8d, each end.

C. Roof And Ceiling Framing:

D. Accessory / Equipment Mounting:

1. Furnish and install blocking in wood framing required for hardware, specialties, equipment, accessories, and mechanical and electrical items, etc.

E. Furring Strips
   1. On Wood or Steel: Nail or screw as required to secure firmly.
   2. On Concrete or Masonry:
      a. Back up furring strips on exterior walls or walls in contact with earth with 15 lb felt strip.
      b. Nail at 12 inches on center maximum.

END OF SECTION

SECTION 06 2001

COMMON FINISH CARPENTRY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install sealants required for items installed under this Section, as described in Contract Documents.

B. Products Installed But Not Supplied Under This Section:
   1. Architectural Casework.
   2. Windows.
   3. Selected Building Specialties.
   4. Selected Equipment.
   5. Miscellaneous as specified elsewhere.

C. Related Sections:
   1. Section 06 1100: Furring and blocking.
   2. Sections under 06 4000 heading: Furnishing of Architectural Woodwork.
   3. Section 06 4001: Quality of wood materials to be used in Finish Carpentry.
   4. Section 07 9213: Quality of sealants, submittal and installation requirements.
   5. Section 08 5113 or 08 5313: Furnishing of Windows.
   6. Sections under 09 9000 heading: Back priming of work to be installed against concrete or masonry or subjected to moisture, and finishing of finish carpentry and architectural woodwork.
   7. Sections in Division 10: Furnishing of Specialties.

1.2 REFERENCES

A. Architectural Woodwork Institute:
   1. AWI, 'Architectural Woodwork Quality Standards, 7th Edition, Version 1.0, 1997.'

1.3 SYSTEM DESCRIPTION

A. Performance Requirements: AWI Custom Grade is minimum acceptable standard, except where explicitly specified otherwise, for installation of architectural woodwork.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Glue: Waterproof and of best quality.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Verify walls, ceilings, floors, and openings are plumb, straight, in-line, and square before installing Architectural Woodwork. Report conditions that are not in compliance to Architect before starting installation.

3.2 PREPARATION

A. Install Architectural Woodwork after wall and ceiling painting is completed in areas where Architectural Woodwork is to be installed.

3.3 INSTALLATION

A. General Architectural Woodwork Installation:
   1. Fabricate work in accordance with measurements taken on Project site.
   2. Scribe, miter, and join accurately and neatly to conform to details.
   3. Exposed surfaces shall be machine sanded, ready for finishing.
   4. Allow for free movement of panels.
   5. Countersink nails. Countersink screws and plug those exposed to view.

B. Items Installed But Not Supplied Under This Section: Install in accordance with requirements specified in Section supplying item.

END OF SECTION

SECTION 06 2024

DOOR, FRAME, AND FINISH HARDWARE INSTALLATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install sealants for calking doorframes as described in Contract Documents.
   2. Furnish and install insulation in doorframes as described in Contract Documents.

B. Products Installed But Not Supplied Under This Section:
   1. Flush wood doors.
   2. Hollow metal doors.
   3. Hollow metal doorframes.
   4. Finish hardware.

C. Related Sections:
   1. Section 07 2116: Quality of fiberglass insulation.
   2. Section 07 9213: Quality of sealants.
   3. Sections under 08 1000 heading: Furnishing of doors and metal frames.
   4. Sections under 08 7000 heading: Furnishing of finish hardware.

1.2 SUBMITTALS

A. Quality Assurance / Control:
   1. Inspection report verifying correct operation and adjustment of installed hardware.
   2. Copy of 'Installation Guide for Doors & Hardware' by Door & Hardware Institute. Guide may be obtained from Door and Hardware Institute (DHI).

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Fire door installations shall meet code requirements.

B. Pre-Installation Conference:
   1. Schedule conference after hardware has been delivered to site and organized into hardware groups by door, but prior to installation of hardware.
   2. Check for appropriate blocking and for correct hardware models and fasteners for substrates.
   3. Review set of Manufacturer's installation, adjustment, and maintenance instructions submitted under Section 08 7101.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Wood Doors:
   1. Do not have doors delivered to building site until after plaster, cement, and taping compound are dry. If doors are to be stored at job-site for more than one week, seal top and bottom edges if not factory sealed.
   2. Store flat on a level surface in a dry, well ventilated building. Cover to keep clean but allow air circulation.
   3. Handle with clean gloves and do not drag doors across one another or across other surfaces.

4. Do not subject doors to abnormal heat, dryness, or humidity or sudden changes therein. Condition doors to average prevailing humidity of locality before hanging.

1.5 OWNER'S INSTRUCTIONS

A. Using Owner's Operations And Maintenance Manual, explain keying systems at same time keys and locking mechanisms are tested.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow Metal Frames:
   1. Site Tolerances:
      a. Squareness: 1/16 inch 1.6 mm from top edge to opposite top edge.
      b. Plumbness: 1/16 inch 1.6 mm from top of jamb to bottom of jamb.
      c. Alignment: 1/16 inch 1.6 mm from plane of left side face of jamb to right side face of jamb.
      d. Twist: 1/16 inch 1.6 mm across throat of jamb plane measured across each face to plane of opposite jamb throat.
      e. Finished Clearance Between Door And Frame:
         1) 1/16 inch 1.6 mm at head and hinge jamb plus 1/16 inch 1.6 mm maximum
         2) 1/8 inch 3 mm at strike jamb plus or minus 1/16 inch 1.6 mm maximum.
         3) 1/2 inch 12 mm to top of finished floor surface or 1/4 inch 6 mm to top of threshold, plus or minus 1/16 inch 1.6 mm maximum.
   2. Set frame in location and level head.
   3. Equalize with adjustable floor anchor.
   4. Set spreaders and fasten jambs to floor and wall.
      a. Wood spreaders shall be square, fabricated from lumber one inch minimum thick, be same length as door opening at header, and same depth as frame.
      b. Cut notches for frame stops.
      c. Do not remove spreaders until frames are permanently anchored in wall.
      d. Use one spreader at base of frame and another at strike level.
      e. Do not use temporary spreaders welded to base of jambs during installation of frame.
   5. Fill gap between frame and framing with urethane foam or tightly-packed fiberglass insulation. If urethane foam is used, coat interior of frames with foam before installing frame. Trim excess before installation of frame.
   6. Calking:
      a. Calk around both sides of frames of doors receiving acoustical seals with specified sealant.

B. Doors:
   1. When Project is completed, doors shall not bind, stick, or be mounted so as to cause future hardware difficulties.
   2. Do not impair utility or structural strength of door in fitting of door, applying hardware, or cutting and altering door louvers, panels, or other special details.

C. Hardware:
   1. General:
      a. Install using set of Manufacturer's installation, adjustment, and maintenance instructions submitted with hardware under Section 08 7101. Follow as closely as possible.
      b. Mount closers on jamb stop side of door in parallel arm configuration where it is physically possible to do so and not damage or hinder operation of door or closer.
   2. Hardware for Wood Doors:

a. If doors are not factory-machined, use hardware templates furnished by Hardware Manufacturer when mounting hardware.
b. Set hinges flush with edge surface. Be sure that hinges are set in a straight line to prevent distortion.
c. Mount door latches high in strike plate opening so when door later settles, latch will not bind.

3.2 FIELD QUALITY CONTROL

A. Tests: Arrange to have keys brought to Project site and, in meeting attended by local representatives and Architect, test every new key and locking mechanism.

END OF SECTION

SECTION 06 4001

COMMON ARCHITECTURAL WOODWORK REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. General standards for materials and fabrication of Architectural Woodwork and for hardware associated with Architectural Woodwork.

B. Related Sections:
   1. Section 06 1100: Furring and blocking.
   2. Section 12 3623: Plastic-Laminate-Clad Countertops.

1.2 REFERENCES

A. Architectural Woodwork Institute:
   1. AWI, 'Architectural Woodwork Quality Standards, 7th Edition, Version 1.0, 1997.'

1.3 SYSTEM DESCRIPTION

A. Performance Requirements: AWI Custom Grade is minimum acceptable standard, except where explicitly specified otherwise, for materials, construction, and installation of architectural woodwork.

1.4 SUBMITTALS

A. Product Data: Manufacturer's literature for specialty items and hardware not manufactured by Architectural Woodwork fabricator.

1.5 DELIVERY, HANDLING, AND STORAGE

A. Assemble architectural woodwork at Architectural Woodwork Fabricator's plant and deliver ready for erection insofar as possible.

B. Protect architectural woodwork from moisture and damage while in transit to job site. Unload and store in place where it will be protected from moisture and damage and convenient to use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber:
   1. Grade:
      a. No defects in boards smaller than 600 sq in 3 871 sq cm.
      b. One defect per additional 150 sq inches 968 sq cm in larger boards.
      c. Select pieces for uniformity of grain and color on exposed faces and edges.

d. No mineral grains accepted.

2. Allowable Defects:
   a. Tight knots not exceeding 1/8 inch 3 mm in diameter. No loose knots permitted.
   b. Patches (dutchmen) not apparent after finishing when viewed beyond 18 inches 450 mm.
   c. Checks or splits not exceeding 1/32 inch by 3 inches 1 mm by 75 mm and not visible after finishing when viewed beyond 18 inches 450 mm.
   d. Stains, pitch pockets, streaks, worm holes, and other defects not mentioned are not permitted.
   e. Normal grain variations, such as cats eye, bird's eye, burl, curl, and cross grain are not considered defects.
3. Use maximum lengths possible, but not required to exceed 10 feet 3 meters without joints. No joints shall occur closer than 72 inches 1 800 mm in straight runs exceeding 18 feet 3 600 mm. Runs between 18 feet 3 600 mm and 10 feet 3 meters may have no more than one joint. No joints shall occur within 72 inches 1 800 mm of outside corners nor within 18 inches 450 mm of inside corners.
4. Moisture content shall be 6 percent maximum at fabrication. No opening of joints due to shrinkage is acceptable.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 06 4005

PLASTIC LAMINATE

PART 1 - GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section:
   1. Wall-hung counters.
   2. Countertops for custom casework.

B. Related Sections:
   1. Section 06 2001:
      a. Installation of wall-hung counters.
      b. Installation of countertops for custom casework.
   2. Section 06 4001: Common Architectural Woodwork Requirements.
   3. Section 22 4200: Plumbing Fixtures.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A161.2-1979 (R1987), 'Performance Standards for Fabricated High Pressure Decorative Laminate Countertops.'

B. National Electrical Manufacturer's Association / American National Standards Institute:
   1. NEMA / ANSI LD-3-2005, 'High Pressure Decorative Laminates.'

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's literature for plastic laminate.
   2. Color selections.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Plastic Laminates:
   1. Quality:
      a. Countertops:
         1) Post-formed front edge and backsplash, except where detailed otherwise, with plastic laminate meeting requirements of ANSI / NEMA LD 3: PF 42.
            a) Vertical Applications: GP 28.
            b) Horizontal (other than countertops): GP 38.
         2) No raised lip on front edge.
      b. Balancing Material: BK 20.
      c. AWI Quality Grade: Premium.
   2. Assemblies:
      a. Countertops shall meet requirements of ANSI A161.2.

b. Adhesives for other than post-formed types shall be spray grade, high heat resistant, neoprene contact adhesive.

3. Type Two Acceptable Manufacturers:
   a. Formica, Cincinnati, OH www.formica.com, all matte finish.
   b. Nevamar, Odenton, MD www.nevamar.com.
   c. Pionite Decorative Surfaces, Auburn, ME www.pionitelaminates.com.
   d. WilsonArt, Temple, TX www.wilsonart.com.
   e. Equal as approved by Architect before bidding. See Section 01 6200.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 06 4110

CUSTOM CASEWORK

PART 1 GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section
   1. Custom casework

B. Related Sections
   1. Section 05500 - Metal Fabrication
   2. Section 06201 - Installation
   3. Section 06401 - General Architectural Woodwork Requirements
   4. Division 16 - Electrical

1.2 SUBMITTALS

A. Product Data - Manufacturer's literature or cut sheets for hardware.

B. Shop Drawings
   1. Confirm compliance with Contract Document requirements as to configuration and dimensions of custom casework.
   2. Custom casework construction and joinery.
   3. Hardware list.

1.3 PROJECT CONDITIONS

A. Environmental conditions: Obtain and comply with Woodwork Manufacturer's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.

B. Field Measurement: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wood & Veneer Specie
   1. Softwood Plywood: Comply with PS 1 "US Product Standard for Construction and Industrial Plywood."
      a. Use A-C grade, unless otherwise indicated.
   2. Softwood Lumber: Kiln dried to 7 percent moisture content or less.
      a. D Grade Eastern White Pine, Sugar Pine, or Idaho White Pine.
   3. Hardwood Lumber: Kiln Dried, 7 percent moisture content or less.
      a. Plain sawn poplar, select and better. Other species at the Contractor's option.
      b. Reception Counter bull-nose: Plain sawn cherry, select and better.

B. Panel Product
   1. For thickness of 3/4" or less: Core shall be matt-formed, high density fiberboard with minimum weight of 45 lbs/cu ft. and shall comply with ANSI A208.1 for Grade 1-M-1.

2. For thickness of 13/16" to 1-1/4": Core shall be matt-formed, high density fiberboard with minimum weight of 44 lbs/cu ft. and shall comply with ANSI A208.1 for Grade 1-M-1.
3. At wet locations: Water resistant high-density particle board made of phenolic resin based materials.
4. Facings -
   a. Melamine or Kortron, 80 gram, fused to particle board.
5. Edgings -
   a. Exposed and semi-exposed edges of panel product with both faces Melamine or Kortron shall have hot-glued 2mm thick PVC edging.
   b. Provide 3mm thick ESI P37195-24 edging at the following locations: door & drawer front edges.
   c. Provide .018" thick ESI P7195-24 edging at the following locations: cabinet edges, and shelf edges (all 4 sides).
6. Glues used in manufacture and fabrication of panel products shall be Type I or II.

C. Cabinet & Drawer Hardware
1. Provide cabinet hardware and accessories in compliance with ANSI A 156.9 “American National Standards for Cabinet hardware”.
2. Cabinet & Drawer Pulls - Hafele 116.24.623 pulls
3. Cabinet & Drawer Locks - “Cam” type, National Cabinet Lock model #C-8055-14A , keyed alike with a master key set labeled and furnished to Facilities & Engineering.
4. Cabinet Adjustable Shelf Supports - Fully adjustable @ 1 1/4" o.c. vert. using 5mm holes with spoon type pins.
5. Cabinet Hinges - Uppers: Blum 120 Deg. Clip Hinge. Base: Blum 170 Deg. Clip Hinge. With Blum 175L8100 Hinge Mounting Plate. Use 2 hinges on doors up to 48" high and 3 hinges on doors over 48 inches high.
6. Wall & Open Shelving - Similar to note 3 except: all wall shelves shall be self edged. Shelf brackets shall be heavy duty, constructed of stainless steel or aluminum so as not to corrode or deteriorate under wet conditions.
7. Drawers - Conventional drawers shall be Blum Metabox 320 series. File drawers shall be Blum Metabox 330H series. Both with Blum Clip Drawer Fixing Brackets. Knee space pencil drawers shall use Blum full extension 150 lbs. rated, model #320.
8. Catches - Positive latching with push to latch/push to release function.
9. Casters – 2” to 3” diameter wheel – designed for 100 lbs minimum capacity

2.2 FABRICATION

A. Cabinet Component Thickness & Material
1. Use Plastic Laminate veneer facing on panel product except on the following surfaces, where Kortron or Melamine shall be used.
   a. Cabinet interiors and shelving faces behind cabinet doors in all rooms.
2. Ends, Divisions, Bottoms, Tops - 3/4 inch panel product.
3. Rails - 3/4 inch panel product.
4. Shelves - Panel product, one inch thick Provide Hafele or equal center supports for spans over 48 inches.
5. Backs - 1/4 inch nominal panel product.
6. Doors - 3/4 inch panel product.
7. Drawer Front - 3/4 inch panel product.
8. Stainless steel corner guards on all outside cabinet corners.

B. Cabinet Construction
1. Reveal overlay without face-frames.
2. Finish any miscellaneous hardwoods with “Flecto varathane” satin laquer finish, 2 coat application, sanded smooth and wiped clean between coats.
3. Fabricate tops to measured field dimensions to correspond to specific installation.

C. Every drawer shall have drawer guides installed.

D. Use number of hinges per leaf as recommended by Hinge Manufacturer.

E. Install plastic grommets in cable access holes in counter-tops: Doug Mockett 3" Gray Cord Grommet

END OF SECTION

SECTION 06 6413

PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install plastic sanitary wall paneling as described in Contract Documents.

1.2 SUBMITTALS

A. Product Data: Manufacturer's product literature.

B. Quality Assurance: Manufacturer's written installation instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. FRP Sanitary Wall Panels:
   1. 0.090 inch thick, white, with embossed surface.
   2. Color Quality Standard: No. 659 White by Glasteel.
   3. Quality Standard: Glasliner by Glasteel.
   4. Category Four Approved Manufacturers. See Section 01 6000 for definitions of Categories.
      a. Glasteel, Moscow, TN www.glasteel.com.
      b. Kemlite, Joliet, IL www.glasbord.com.
      c. Marlite Sanitary Wall & Ceiling Products, Dover, OH www.marlite.com.
      d. Nudo Products Inc, Springfield, IL www.nudo.com.

2.2 ACCESSORIES

A. Use Panel Manufacturer’s standard vinyl moldings at joints, edges, and corners.

PART 3 - EXECUTION: Not Used

END OF SECTION

DIVISION 07: THERMAL AND MOISTURE PROTECTION

07 1000 DAMPPROOFING AND WATERPROOFING

07 1113 BITUMINOUS DAMPPROOFING
07 1350 FOUNDATION DRAINAGE AND WATERPROOFING SYSTEM
07 1352 MODIFIED BITUMINOUS SHEET WATERPROOFING: Below Grade

07 2000 THERMAL PROTECTION

07 2113 BOARD INSULATION
07 2116 BLANKET INSULATION
07 2123 LOOSE-FILL INSULATION
07 2613 VAPOR RETARDER

07 5000 MEMBRANE ROOFING

07 5419 POLYVINYL-CHLORIDE ROOFING / PVC

07 6000 FLASHING AND SHEET METAL

07 6210 GALVANIZED STEEL FLASHING & TRIM

07 7000 ROOF AND WALL SPECIALTIES AND ACCESSORIES

07 7233 ROOF HATCHES

07 9000 JOINT PROTECTION

07 9213 ELASTOMERIC JOINT SEALANTS

END OF TABLE OF CONTENTS

SECTION 07 1113

BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and apply bituminous dampproofing to exterior of foundation walls and top of associated footings as described in Contract Documents.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Maintain dampproofing at 40 deg F or above before application.

1.3 PROJECT CONDITIONS

A. Project Environmental Requirements: Do not apply when ambient temperature is below 40 deg F, surface temperature is below 33 deg F, or when rain is expected before applied dampproofing will dry.

1.4 SCHEDULING

A. Do not backfill against bituminous dampproofing for 24 hours after application.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type Two Acceptable Products:
   1. Ecomul-11 by Epro Waterproofing Systems, Derby, KS www.eproserv.com.
   2. Henry 788 by Henry Company, Huntington Park, CA www.henry.com.
   3. Karnak 100 by Karnak Chemical Corp, Clark, NJ www.karnakcorp.com.
   4. Sealmastic Asphalt Emulsion Dampproofing Type I by W R Meadows, Hampshire, IL www.wrmeadows.com.
   5. Equal as approved by Architect before application. See Section 01 6200.

PART 3 - EXECUTION

3.1 APPLICATION

A. Spray Application: Spray to a thickness of 10 mils minimum.

B. Brush / Roller Application: Apply two coats of dampproofing at rate recommended by Manufacturer. Apply coats in cross hatch method so coats are applied perpendicular to each other. Before applying second coat allow first coat to dry in accordance with Manufacturer's recommendations.

C. Apply dampproofing to cover area from 6 inches below finish grade line down to and including top of footings.

END OF SECTION

SECTION 07 1350

FOUNDATION DRAINAGE AND WATERPROOFING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Preparation of concrete surfaces and installation of sheet membrane waterproofing as described in Contract Documents.

B. Related Sections:
   1. Section 03 3111: Concrete.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM D 412-98a, 'Test Methods Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.'
   2. ASTM D 570-98, 'Test Method for Water Absorption of Plastics.'
   3. ASTM D 751-00, 'Test Methods for Coated Fabrics.'
   4. ASTM D 882-01, 'Test Method for Tensile Properties of Thin Plastic Sheeting.'
   5. ASTM D 1970-01, 'Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as steep Roofing Underlayment for Ice Dam Protection.'
   6. ASTM D 3767-01, 'Practice for Rubber B Measurement of Dimensions.'
   7. ASTM E 96-00, 'Test Methods for Water Vapor Transmission of Materials.'
   8. ASTM E 154-99, 'Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.'

B. Underwriters Laboratories:
   1. UL 790, 'Tests for Fire Resistance of Roof Covering Materials.'

1.3 SUBMITTALS

A. Product Data: Manufacturer's product literature.

B. Quality Assurance / Control:
   1. Certification indicating Manufacturer's acceptance of installer as an approved applicator for specified materials.
   2. Manufacturer's written installation instructions.

1.4 QUALITY ASSURANCE

A. Pre-Installation Conference: Schedule conference after preparation of substrate but before beginning installation of system.

1.5 WARRANTY

A. Provide Manufacturer's extended 10-year warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original, factory-sealed, unopened containers bearing manufacturer's name and label intact and legible with following information.
   1. Name of material.
   2. Manufacturer's stock number and date of manufacture.
   3. Material safety data sheet.

B. Store materials in protected and well ventilated area.

1.7 PROJECT CONDITIONS

A. Do not apply membrane when surface temperature is below, or inclement weather conditions conflict with, Manufacturer's published requirements.

PART 2 - PRODUCTS

2.1 MATERIALS - The system described below is the design standard.

A. Self-Adhesive Sheet Membrane Waterproofing.
   1. CCW MiraDRI 860/861 consisting of 56 mil rubberized asphalt membrane laminated to 4 mil cross-laminated polyethylene film, and meeting following requirements:
      a. Tensile Strength: 325 psi minimum, ASTM D 412.
      b. Ultimate Elongation: 350 percent minimum, ASTM D 412.
      c. Puncture Resistance: 60 lbs minimum, ASTM E 154.
      d. Permeance: 0.05 Perm maximum, ASTM E 96 (B).
      e. Low Temperature Flexibility: Unaffected at minus 45 deg F, ASTM D 1970, one inch mandrel.
      f. Tensile to Film: 5000 psi, ASTM D 882.
      g. Thickness: 60 mils, ASTM D 3767.
      h. Hydrostatic Head: 230 ft, ASTM D 751.
      i. Water Absorption: 0.1 percent by weight, ASTM D 570.

B. Surface Primer: CCW-702 Solvent-based Primer, CCW AWP Water-Based Primer, or CCW-714 Water-Based Primer.

C. Mastic: CCW-704 Mastic.

D. Sealants: CCW-703 Vertical Grade Liquiseal[7] Membrane, PT-304 one component, CCW-201 two component Polyurethane Sealant, or CCW LM-800XL.

E. Backing Rod: Closed-cell polyethylene foam rod.

F. Protection Course: CCW Protection Board-V or CCW 200V for vertical surfaces.

G. Drainage Composite: CCW MiraDRAIN[7] as recommended by Manufacturer for each condition.

H. Perimeter Drainage System: CCW QuickDRAINJ.

2.2 MANUFACTURER

A. Design Standard: Carlisle Coatings and Waterproofing Incorporated, Wylie, Texas (800) 527-7092. www.carlisle-ccw.com.

B. Other manufacturers of equivalent systems.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before beginning work of this Section, examine surfaces to receive system for deficiencies. Notify Architect in writing of deficiencies. Do not begin work of this Section until deficiencies are corrected.

3.2 SURFACE PREPARATION

A. Clean concrete surface of surface contaminates and cleaning residue that may harmfully affect adhesion of membrane. Let concrete surface dry.

B. Install 3/4 inch face, 45 degree cant of appropriate sealant at angle changes and inside corners, including penetrations through deck, walls, curbs, etc.

C. Rout out cracks over 1/16 inch in width and moving cracks under 1/16 inch in width to 1/4 inch minimum in width and depth and fill flush with appropriate sealant.

D. Clean and prime expansion joints less than one inch wide, fit with backing rod, and calk with appropriate sealant. For larger joints, contact Manufacturer's representative.

E. Allow sealant to cure overnight minimum.

F. Stir Primer. Apply thin film of primer 10 inches wide, centered over sealed cracks and joints, hairline cracks, and cold joints. Apply primer 8 inches on each side of corners. Prime concrete around drain flanges. Allow primer to dry in accordance with Manufacturer's recommendations.

G. Install 8 inch wide strip of membrane centered over joints and cracks. Install 12 inch wide strip of membrane centered over axis of corners.

H. Terminate membrane around drains in accordance with Manufacturer's details. Terminate membrane under clamping ring. Seal edges with mastic. Do not interfere with weep holes.

3.3 APPLICATION

A. For application temperatures between 25 and 65 deg F, use CCW-861 Sheet Membrane and CCW-702 primer. For application temperatures above 40 deg F, use CCW MiraDRI 860 sheet membrane and CCW-702, CCW-714, or CCW-AWP primer.

B. Priming:
   1. Clean surfaces to remove residual dust before priming.
   2. Stir primer. Apply by spray or roller at a rate recommended by Manufacturer.
   3. Allow to dry in accordance with Manufacturer's recommendation.

C. Horizontal surfaces:
   1. Install sheet membrane from low to high point, so laps will shed water. Overlap edge seams 2-1/2 inches and end laps 5 inches. Stagger end seams.
   2. Roll in place with 18 to 24 inch wide, 100 lb minimum, resilient roller. Ensure that laps are firmly adhered and that there are no gaps or fishmouths.

D. Vertical Surfaces:

1. Apply in lengths of 8 feet or less. Overlap edge seams 2-1/2 inches. On walls over 8 feet high, apply in 8-foot sections, starting at lowest point with higher section overlapping lower section 5 inches.
2. Roll in place using firm pressure with hand roller.

E. Terminations: Roll terminating edges firmly. Apply mastic to terminations and 'T' joints. Apply mastic or Liquiseal to laps at angle changes, extending 9 inches in each direction.

F. Flood Test:
1. After sheet membrane has been in place at least 24 hours, plug drains and provide barriers necessary to contain floodwater. Consult with structural engineer for deck loading limits before conducting water test.
2. Flood surface with 2-inch head of water for 24 hours. Inspect for leaks and repair membrane if leaks are found. Retest after making repairs.

G. Protection Course:
1. Vertical Application: Install perimeter drainage system as first course of drainage composite immediately after membrane has been installed on vertical surfaces. Install drainage composite and appropriate protection board on remainder. Stop drainage composite 6 inches below final grade level.
2. Horizontal Application: Install drainage composite or protection board immediately after flood testing on horizontal surfaces. If flood testing is delayed, install temporary covering to protect membrane from damage.

END OF SECTION

SECTION 07 1352

MODIFIED BITUMINOUS SHEET WATERPROOFING: Below-Grade

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install membrane waterproofing as described in Contract Documents.

1.2 SUBMITTALS

A. Product Data: Where applicable, provide three copies of Manufacturer's standard, OSHA approved Materials Safety Data Sheets.

B. Quality Assurance / Control: Applicator's certification from Membrane System Manufacturer.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Applicator shall have approval of Membrane System Manufacturer. Submit certification of this approval before commencing work.
   2. Membrane Manufacturer shall provide accessories and related materials, unless specified otherwise.

1.4 WARRANTY

A. Furnish Manufacturer's ten-year materials and labor warranty on total system.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Membrane:
   1. For Application At Temperatures Above 40 deg F 4 deg C:
      a. Bituthene System 3000 by Grace.
      b. Elasto-Ply 60 mil Membrane by Karnak.
      c. Sealtight Mel-Rol by W R Meadows.
   2. For Application At Temperatures Between 25 and 40 deg F minus 4 and 4 deg C:
      a. Bituthene System 3100 by Grace.
      b. Elasto-Ply 60 mil Membrane by Karnak.
      c. Sealtight Mel-Rol by W R Meadows.

B. Primers:
   1. For Application At Temperatures Above 40 deg F 4 deg C:
      a. P-3000 by Grace.
      b. No 2000 primer by Karnak.
      c. Sealtight Mel-Prime by W R Meadows.
   2. For Application At Temperatures Between 25 and 40 deg F minus 4 and 4 deg C:
      a. P-3100 by Grace.
      b. No 3000 primer by Karnak.

c. Sealtight Mel-Prime by W R Meadows.

C. Elastomeric Mastic:
1. EM-3000 by Grace.
2. No 81 Rubberized mastic by Karnak.
3. Sealtight Pointing Mastic by W R Meadows.

D. Liquid Membrane:
1. LM-3000 by Grace.
2. W-1 One-Kote by Karnak.
3. Sealtight Liquid Membrane by W R Meadows.

E. Protection Board: 1/8 inch 3 mm backer board:
1. PB-3000 by Grace.
2. As recommended by Karnak.
3. PC-1 Protection Course by W R Meadows.

F. Protection Board Adhesive:
1. PBA-3000 by Grace.
2. As recommended by Karnak.
3. Sealtight Pointing Mastic by W R Meadows.

G. Pre-Fabricated Composite Drainage Board:
1. HSF Hydroduct by Grace.
2. As recommended by Karnak.
3. Tremdrain 1000 by Tremco.
4. As recommended by W R Meadows.

2.2 MANUFACTURERS

A. Category Four Approved Manufacturers:
1. Grace Construction Products, Cambridge, MA www.na.graceconstruction.com.
2. Karnak Corporation, Clark, NJ www.karnakcorp.com.
3. Tremco Inc, Cleveland, OH www.tremcosealants.com.
4. W R Meadows, Hampshire, IL www.wrmeadows.com.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS

A. Same Pre-qualified Roofing Sub-Contractor selected for roofing installation, or.

B. Waterproofing applicator shall be pre-approved and included in Construction Documents by Addendum.

3.2 EXAMINATION

A. Concrete surfaces shall be smooth, and monolithic with no voids, spalled areas, loose aggregate, sharp protrusions, or finishes other than smooth troweled. Concrete shall have cured seven days minimum after form removal and be dry at time of application.

3.3 APPLICATION

A. Install system variants as follows:

1. Type 1:
    a. Applied to vertical surfaces where shown on Drawings.
    b. Consists of membrane and protection board.
2. Type 2:
    a. Applied to horizontal surfaces where shown on Drawings.
    b. Consists of membrane and drainage board.

B. Apply primer with lambswool roller at the rate of 250 to 350 sq ft per gal 5 to 7 m^2 per liter:
    1. Allow to dry until tack free, one hour minimum. Do not prime area larger than can be covered in one working day.
    2. Re-prime areas left overnight.

C. Apply membrane vertically in 8 foot 2 400 mm maximum strips with vertical and horizontal joints lapping 2-1/2 inches 63 mm minimum.
    1. Press membrane on vertical surfaces with heavy hand pressure during application.
    2. Press top edges with metal or wood hammer or knife handle.

D. Type 1:
    1. Seal daily and permanent terminations with thin-troweled bead of specified mastic on vertical surfaces. Do not permanently expose to sunlight.
    2. Apply specified protection board adhesive and protection board.

E. Type 2: Apply specified drainage board to horizontal surfaces.

3.4 FIELD QUALITY CONTROL

A. Inspection:
    1. Manufacturer's Technical Representative shall inspect installed systems for vertical and horizontal installations before backfilling occurs.
    2. Notify Manufacturer's Representative and Architect 48 hours before backfilling.

END OF SECTION

SECTION 07 2113

BOARD INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install board insulation on interior side of perimeter foundation walls and under floor slabs as described in Contract Documents.

B. Products Installed But Not Supplied Under This Section:
   1. Polyethylene Film Vapor Retarder

C. Related Sections:
   1. Section 07 2613: Furnishing of polyethylene film vapor retarder.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM C 578-01, 'Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.'
   2. ASTM C 1289-01, 'Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.'

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type 1 Insulation: Below Grade:
   1. Meet requirements of ASTM C 578, Type IV.
   2. Type One Acceptable Products:
      a. Amofoam CM by Pactiv Building Products, Lake Forest, IL www.pactiv.com/green-guard.
      b. Foamular 250 by Owens Corning, Toledo, OH www.owens-corning.com.
      c. Styrofoam SM by Dow Chemical, Midland, MI www.dow.com.
      d. Equal as approved by Architect before bidding. See Section 01 6200.

B. Adhesive For Type 1 Insulation:
   1. Type Two Acceptable Products:
      a. Pro Series QB-300 by Ohio Sealants, Mentor, OH www.osiproseries.com.
      b. Equal as approved by Architect before use. See Section 01 6200.

2.2 SOURCE QUALITY CONTROL

A. Insulation shall be manufactured to be in compliance with UBC or other applicable building codes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install insulation in compliance with UBC or other applicable building codes.

B. Type 1 Insulation:
   1. Remove ties and concrete protrusions that would keep insulation from fully contacting foundation wall face.
   2. Install against interior side of perimeter foundation walls extending downward from top of slab 48 inches or to top of footing, whichever is less. Install using 3/8 inch beads of specified adhesive at 12 inches on center vertically and at each vertical and horizontal joint to completely seal insulation.
   3. Install horizontally for 48 inches under building slab continuously around building perimeter and between slab and foundation wall for full depth of slab.

END OF SECTION

SECTION 07 2116

BLANKET INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install faced thermal and acoustic batt insulation as described in Contract Documents.

B. Related Requirements:
   1. Section 06 2024: Furnishing and installing of insulation in ungrouted hollow metal door frames.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM C 665-06, 'Standard Specification for Mineral-Fiber Thermal Insulation For Light Frame Construction and Manufactured Housing.'

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
   1. Type One Acceptable Manufacturers:
      a. Certainteed Corp, Valley Forge, PA www.certainteed.com.
      b. Guardian Fiberglass, Greer, SC www.guardianbp.com.
      c. Knauf Fiber Glass, Shelbyville, IN www.knaufusa.com.
      d. Owens-Corning Fiberglass Corporation, Toledo, OH www.owens-corning.com.
      e. Johns Manville, Denver, CO www.jm.com.
      f. Thermafiber, Wabash, IL www.thermafiber.com.
      g. Equal as approved by Architect before bidding. See Section 01 6200.

B. Materials:
   1. Thermal And Acoustic Insulation:
      a. Faced Insulation:
         1) Kraft faced meeting requirements of ASTM C 665, Type II, Class C.
         2) Foil faced meeting requirements of ASTM C 665, Type III.
            a) Class B: Enclosed insulation.
            b) Class A: Exposed insulation.
      b. Order insulation by 'R' factor rather than 'U' factor, rating, or thickness, either 16 or 24 inches wide according to framing spacing.
      c. 'R' Factor Required:
         1) Acoustically Insulated Ceilings:
            a) Enclosed Spaces: Fill framed cavity with batt of appropriate thickness.
            b) Unenclosed Spaces: R38.
         2) Wood or Metal Wall Stud Framing:

R11	3-1/2 inches deep	
R19	5-1/2 inches deep	

R26	7-1/2 inches deep	

3) Thermally Insulated Ceilings / Roof:
   a) R38 Cathedral / High Density: At 2x12 Overbuild Framing.
   b) R38 Standard: All Other.

2.2 SOURCE QUALITY CONTROL

A. Insulation shall be manufactured to be in compliance with IBC or other applicable building codes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Leave no gaps in insulation envelope.
   2. If two layers of insulation are used to attain required 'R' factor, only layer towards interior of building shall have facing.
   3. Provide minimum clearance around recessed lighting fixtures as approved by local code.

B. In Framing:
   1. Install insulation behind plumbing and wiring, around duct and vent line penetrations, and in similar places.
   2. Fit ends of batts snug against top and bottom plates.
   3. Where insulation is not enclosed by structure or drywall, support in place with wire or other suitable material and use only foil-faced insulation.
   4. Install baffles between trusses and rafters at ventilation spaces if necessary to prevent insulation from blocking airflow from soffit.

END OF SECTION

SECTION 07 2123

LOOSE-FILL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install thermal loose-fill insulation as described in Contract Documents.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM C 764-01, 'Standard Specification for Mineral-Fiber Loose-Fill Thermal Insulation.'
   2. ASTM C 1015-02, 'Standard Practice for Installation of Cellulosic and Mineral-Fiber Loose-Fill Thermal Insulation.'

PART 2 - PRODUCTS

2.1 MATERIALS

A. Thermal Insulation:
   1. Meet requirements of ASTM C 764, Type I.
   2. 'R' Factor Required: R38
   3. Type One Acceptable Manufacturers:
      a. Certainteed Corp, Valley Forge, PA www.certainteed.com.
      b. Guardian Fiberglass, Albion, MI www.guardianfiberglass.com.
      c. Knauf Fiber Glass, Shelbyville, IN www.knauffiberglass.com.
      d. Owens-Corning Fiberglass Corporation, Toledo, OH www.owens-corning.com.
      e. Johns Manville, Denver, CO www.jm.com.
      f. Thermafiber, Wabash, IL www.thermafiber.com.
      g. Equal as approved by Architect before bidding. See Section 01 6000.

2.2 SOURCE QUALITY CONTROL

A. Insulation shall be manufactured to be in compliance with IBC or other applicable building codes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install insulation in compliance with requirements of ASTM C 1015.

B. Leave no gaps in insulation envelope.

C. Do not cover recessed light fixtures with insulation. Cut out insulation to provide 6 inch minimum clearance around recessed lighting fixtures.

D. Install baffles between trusses and rafters at ventilation spaces if necessary to prevent insulation from blocking airflow from soffit.

END OF SECTION

SECTION 07 2613

VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install polyethylene film vapor retarders on framed walls and ceilings as described in Contract Documents.

1.2 REFERENCES

A. American Society for Testing and Materials:
   1. ASTM D 4397-02, 'Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.'

PART 2 - PRODUCTS

2.1 MATERIALS

A. Vapor Retarder: 6 mil minimum clear polyethylene sheets meeting requirements of ASTM D 4397.

2.2 ACCESSORIES

A. Lap Sealant:
   1. Type Three Acceptable Products:
      a. Narrow Joint Sealer by Schnee-Morehead Inc, Irving, TX www.trustsm.com.
      b. Equal as approved by Architect before use. See Section 01 6000.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install using 1/2 inch long minimum staples through thin cardboard disc or strip reinforcement. Staple every 6 inches along structural members and blocking and 3 inches in from sheet edge. Run long edge of sheet along structural members.

B. Bed joints in specified sealant or seal with vapor resistant tape of type recommended by Manufacturer for vapor retarder installation.

C. Seal penetrations through vapor retarder immediately before installation of gypsum board.

3.2 FIELD QUALITY CONTROL

A. Inspection:
   1. Vapor retarder is to be air tight and free from holes, tears, and punctures.

a. Immediately before installation of gypsum board, inspect vapor retarder for holes, tears, and punctures and repair damaged areas.
b. Immediately before completion of Project, inspect exposed vapor retarder for holes, tears, and punctures and repair damaged areas.

END OF SECTION

SECTION 07 5419

POLYVINYL-CHLORIDE ROOFING / PVC

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited to:
   1. Install roofing membrane with flashings and other components to comprise total roofing system as described in Contract Documents.

B. Related Sections:
   1. 07 1352 – Modified Bituminous Sheet Waterproofing system shall be installed by the roofing contractor.

1.2 SUBMITTALS

A. Product Data: Roofing Manufacturer's literature or cut sheet for each element of system.

B. Shop Drawings:
   1. Prepared by Roofing Manufacturer or its representative. Include outline of roof and roof size, location and type of penetrations, perimeter and penetration details, special details, and bill of materials.
   2. Confirm that specified FM Class and UL Class assembly is appropriate for Project location.
   3. Include approved copy of Manufacturers Notice of Award.

C. Quality Assurance / Control:
   1. Two copies of Roofing Manufacturer's published specification for Architect and maintain one at job-site.
   2. Roofing Manufacturer's certification of Installer.
   3. Submit evidence that roof system has been tested and approved or listed as follows:
      a. FM Class 1-90.
      b. UL Class A assembly.

D. Closeout: Submit record shop drawings to Roofing Manufacturer, if requested. Record shop drawings shall be given shop drawing number by Roofing Manufacturer.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Roofing system shall be applied by Applicator authorized by Roofing Manufacturer before bid.
   2. Membrane and flashing installation shall be performed by personnel trained and authorized by Roofing Manufacturer.
   3. Welding equipment shall be provided by or approved by Roofing Manufacturer. Mechanics intending to use equipment shall have successfully completed training course provided by Manufacturer's Technical Representative before welding.

B. Regulatory Requirements:
   1. Metal details, fabrication practices, and installation methods shall conform to applicable requirements of following:
      a. Factory Mutual Loss Prevention Data Sheet 1-49 (latest issue).
      b. Sheet Metal and Air Conditioning Contractors National Association Inc, 5th edition.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products job site in original unopened containers or wrappings bearing all seals and approvals.

B. Handle materials to prevent damage. Place materials on pallets and fully protect from moisture.

C. Store membrane rolls lying down on pallets fully protected from weather with clean canvas tarpaulins.

D. Cover insulation stored on job site to protect from moisture and UV rays. Factory wrap is not an acceptable cover material.

E. Store insulation elevated off the ground or roof deck to protect from moisture.

F. Do not store or use flammable adhesives vicinity of open flames, sparks, and excessive heat.
   1. Store adhesives at temperatures above 40 deg F 4 deg C.
   2. Store flammable materials in cool, dry area away from sparks and open flames. Follow precautions outlined on containers or supplied by material manufacturer/supplier.

G. Remove from job site materials that are determined to be damaged by Architect or by Roofing Manufacturer and replace at no additional cost to Owner.

H. Take precautions that storage and application of materials and equipment does not overload roof deck or building structure.

1.5 WARRANTY

A. Provide Roofing Manufacturer's 20-year system warranty on form included at the end of this section.

B. Provide Contractor's 5-year warranty included at the end of this section.

1.6 ROOFING HISTORY

A. Complete "DFCM Roofing History Record" included at the end of this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All products (including insulation, fasteners, fastening plates and edgings) must be **manufactured and supplied** by the roofing system manufacturer and covered by the warranty.

B. Membrane: fiberglass reinforced PVC.
   1. Energy Star Rated
   2. Only sheets with stable or low migrating plasticizers will be acceptable.
   3. Manufactured with low-wicking scrim, near center of membrane with no less than 20 mils polymer above scrim.
   4. Meet or exceed ASTM D 4434 for linear dimension al change and for heat aging
   5. Meet or exceed ASTM D 5635 for dynamic impact resistance
   6. Meet or exceed ASTM D 2136 for low temperature flexibility.
   7. Surface Color: White.
   8. Membrane thickness: 60 mil.

C. Approved Products:
   1. Carlisle-SynTec; Sure-Flex or

2. Any UL listed Class-A PVC roof system, **approved by Architect**, meeting or exceeding the performance standard by the following manufacture's:
   a. Gaf; 973-628-3000
   b. Versico; 800-992-7663
   c. Sarnafill; 781 828 5400
   d. JohnsManville; 800-654-3103

2.2 ROOF DRAINS

A. New Drains:
   1. Cast iron body with 2" high water dam, extension sleeve for insulation, under deck clamp, sump receiver and cast iron dome.

2.3 ACCESSORY PRODUCTS

A. Insulation:
   1. All insulation must be covered under the appropriate DFCM manufacturer's warranty for low slope roofing.
   2. All insulation incorporated in the roofing system must be approved and documented as a UL rated assembly that meet code requirements of the building roofing system it is installed in.
   3. When applicable, insulation shall be installed in multiple layers. The first and second layer of insulation shall be mechanically fastened to the substrate in accordance with the manufacturer's published specifications.
   4. Insulation shall be a minimum of 3" thick Sure-Seal Polyiso HP-DWD as supplied by Carlisle.
   5. Insulation boards shall be Factory Mutual Class 1-90 approved.
   6. Insulation panels directly under adhered roofing membrane shall not exceed 48 inches by 48 inches 1 200 mm by 1 200 mm.
   7. Insulation shall have minimum 'R' value of 5 and thickness of one inch 25 mm.
   8. Insulation Adhesive:
      a. Low rise foam adhesive.
      b. Approved Products.
         1) Weathertite Adhesive by Millenium Adhesive Products Inc.
         2) Olybond 500 by Olympic Manufacturing Group (OMG).
         3) LR2001 by Sarnafil
   9.

B. Vapor Retarder:
         1) Plastic sheet vapor retarder as specified in section 07 2613
         2) Install below insulation.

C. Membrane Adhesives, sealants and cleaners:
   1. All products shall be furnished by Membrane manufacture specifically formulated for the intended purpose,
   2. Bonding Adhesive: Sure-Flex PVC or Aqua Base 120 Bonding Adhesive or Membrane manufacturer's standard product.
   3. Edge Sealant: Membrane manufacturer's standard product.
   4. Sealer / Water Cut-Off Mastic: Membrane manufacturer's standard product.
   5. Pocket Sealant: One Part Pourable Sealer
   6. Cleaner: PVC Membrane Cleaner

D. Walkway Pad: 1/4 inch 6 mm thick molded pad made of recycled material with welding tabs. Use left and right turns, end panels, T-panels, etc, to install continuous rooftop walkway network.

E. PVC Coated Metal Flashing: 0.023 inch 0.56 mm thick G90 galvanized sheet metal laminated with 0.020 inch 0.51 mm thick membrane.

F. Prefabricated expansion joint cover with foam tubing, galvanized metal nailing flanges, and membrane welding tabs.

G. Felt mat used as asphalt barrier and smoothing / leveling layer.

H. Prefabricated drain with seal and strainer.

I. Prefabricated accessories pipe flashings and inside and outside corners made of PVC membrane.

J. Reglet: Heavy aluminum flashing termination with stiffening ribs and sealant support shelf used at walls and tall curbs when counterflashings are unavailable. Reglet inside and outside corners are used to install continuous termination.

K. Fastener: Self-tapping, corrosion resistant fastener used to attach insulation board or to fasten membrane at changes in slope.

L. Fastener plate: 26 ga 0.478 mm, 3 inch 75 mm plate used with fasteners to clamp insulation boards in place.

M. Prefabricated membrane vent pipe flashing made of membrane.

2.06 METAL EDGING AND MEMBRANE TERMINATIONS

A. **Drip Edge**: a metal fascia/edge system with a 22 or 24 gauge continuous anchor cleat and .032 inch thick aluminum or 24 gauge steel fascia. Metal fascia color shall be as designated by the Owner's Representative.

B. **Coated Metal**: 4'x 10' coated metal sheets made from 24 gauge galvanized steel with a minimum .035" thick non-reinforced white Sure-Flex laminate. Sure-Flex membrane can be welded directly to the Sure-Flex Coated Metal in accordance with the manufacturer's detail.

C. **Termination Bar**: a 1 inch wide and .098 inch thick extruded aluminum bar pre-punched 6 inches on center; incorporates a sealant ledge to support Lap Sealant and provide increased stability for membrane terminations.

2.4 RELATED MATERIALS

A. Miscellaneous Flashing Materials: As supplied by Roofing Manufacturer.

B. Wood Nailers:
   1. Wood nailers, No. 2 quality or better Douglas Fir. Creosote or asphaltic-treated wood is not acceptable.
   2. Wood nailers shall conform to Factory Mutual's Loss Prevention Data Sheet 1-49.
   3. Wood shall have a maximum moisture content of 19 percent by weight on dry weight basis.

C. Vapor Retarders:
   1. As approved in writing by vapor retarder manufacturer and Roofing Manufacturer for intended use.
   2. Vapor Retarder Fastener / Adhesive:
      a. Fasteners: Meet code and/or insurance requirements. Fasteners shall be approved by Vapor Retarder Manufacturer, Factory Mutual, and Roofing Manufacturer.
      b. Adhesives: Type III steep asphalt, conforming to ASTM D 312 for securing of asphalt base sheet vapor retarders to approved substrates as accepted by Roofing Manufacturer.

D. Sealants and Pitch Pocket Fillers: As accepted by Roofing Manufacturer under specified warranty.

E. Miscellaneous Fasteners And Anchors:
   1. Fasteners, anchors, nails, straps, bars, etc shall be of post-galvanized zinc or cadmium-plated steel, aluminum, or stainless steel. Mixing metal types and methods of contact shall be in such a manner as to avoid galvanic corrosion.
   2. Fasteners for attachment of metal to masonry shall be expansion type fasteners with stainless steel pins.
   3. Concrete fasteners and anchors shall have minimum embedment of 1-1/4 inch 32 mm and shall be approved for such use by Fastener Manufacturer.
   4. Wood fasteners and anchors shall have embedment of one inch 25 mm minimum and be approved for such use by Fastener Manufacturer.

F. Antenna to pipe connector clamps:
   1. Manufacturer: Connect-it
   2. Phone (561) 743-8141, toll free (866) 781-1300, fax (561) 743-9618.
   3. Product: Adaptor sets for round members.
   4. Provide adaptor sets for pipe and antenna sizes encountered.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:
   1. Verify that roof drain lines are functioning correctly before starting work of this Section. Report blockages in writing to Owner's representative, with copy to Roofing Manufacturer, for corrective action before beginning work of this Section.
   2. Stop work immediately if any unusual or concealed condition is discovered and immediately notify Owner in writing, with letter copy to Roofing Manufacturer.

B. Inspect for defects such as excessive surface roughness, contamination, structural inadequacy, or any other condition that will adversely affect quality of work.
   1. Steel Deck: Bring rusted or deteriorated decking to attention of Owner's representative to determine method of treatment or replacement. Lightly sand rusted metal and treat with rust-inhibiting paint. Remove and replace sections that have rusted through. Deck attachment shall conform to FM Data Sheet I-28 and local code requirements.

C. Install continuous treated wood nailers at perimeter of entire roof and around roof projections and penetrations as described on Project Drawings.
   1. Anchor nailers to resist minimum force of 300 pounds per lineal foot in any direction. Provide 1/2 inch13 mm space between nailer lengths. Individual nailer lengths shall not be less than 36 inches 900 mm long. Nailer fastener spacing shall be at 12 inches 300 mm on center, or 16 inches 400 mm if necessary to match structural framing. Stagger fasteners 1/3 nailer width and install within 6 inches 150 mm of each end. Meet requirements current Factory Mutual Loss Prevention Data Sheet 1-49.
   2. Thickness shall match substrate or insulation height.

D. Substrate shall be clean, smooth, dry, free of flaws, sharp edges, loose and foreign material, oil and grease. Roofing shall not start until defects have been corrected.

3.2 INSTALLATION

A. Approved Roofing Contractors:
   1. Roofing Contractors must be on the current (2009) list of Pre-qualified Roofing Contractors found at the end of this section.

B. General:
   1. Roof surfaces shall be free of water, ice and snow. Surfaces to receive new insulation, membrane, or flashings shall be dry. Should surface moisture occur, provide equipment necessary to dry surface before application.
   2. Secure new and temporary construction, including equipment and accessories, so as to preclude wind blow-off and subsequent roof or equipment damage.
   3. Install only as much roofing as can be made weathertight each day, including flashing and detail work. Clean seams and heat-weld before leaving jobsite.
   4. Schedule and execute work without exposing interior building areas to effects of inclement weather. Protect existing building and its contents against all risks.
   5. Install uninterrupted waterstops at end of each day's work and completely remove before proceeding with next day's work. Waterstops shall not emit dangerous or unsafe fumes and shall not remain in contact with finished roof as installation progresses. Replace contaminated membrane at no additional cost to Owner.
   6. Avoid use of newly constructed roofing as walking surface or for equipment movement and storage. Where such access is required, provide necessary protection and barriers to segregate work area and to prevent damage to adjacent areas. Provide protection layer consisting of plywood over insulation board and roofing membrane for new roof areas that receive rooftop traffic during construction.
   7. Before and during application, remove dirt, debris, and dust from surfaces either by vacuuming, sweeping, blowing with compressed air, or similar methods.
   8. Report rooftop contamination that is anticipated or that is occurring to Roofing Manufacturer to determine corrective steps to be taken.

C. Vapor Retarder / Air Barrier Installation:
   1. Steel Deck: Lay vapor retarder directly over deck with side and end joints sealed in accordance with manufacturer's instructions. Vapor retarder may be loosely laid or adhered with adhesive supplied or recommended by same manufacturer.

D. Insulation:
   1. Where specified or required, install insulation as recovery layer over existing substrate and to obtain desired thermal value.
   2. Neatly cut insulation cut to fit around penetrations and projections.
   3. Install tapered insulation in accordance with insulation manufacturer's shop drawings.
   4. Install tapered insulation around drains creating a drain sump.
   5. Do not install more insulation board than can be covered with roofing membrane by end of day's work or onset of inclement weather.
   6. Mechanical Attachment:
      a. Fasten to deck with approved fasteners and plates in accordance with Insulation Manufacturer's, Factory Mutual's, and Roofing Manufacturer's recommendations for fastening rates and patterns. Quantity and locations of fasteners and plates shall also result in insulation boards resting evenly on roof deck/substrate so there are no large cavities or air spaces between boards and substrate.
      b. Install fasteners in accordance with fastener manufacturer's recommendations. Fasteners are to have minimum penetration into structural deck as recommended by Fastener Manufacturer and Roofing Manufacturer.
   7. Adhesive Attachment:
      a. Set insulation into continuous coat or properly spaced ribbons of specified adhesive. Weigh down adhered insulation until adhesive cures.
      b. Insulation shall be fully bonded to substrate or vapor retarder.
      c. Sarnabar fastened 12 inches 300 mm on center to structural concrete deck with approved fasteners is required. Install Sarnabar 48 inches 1 200 mm in from roof edge around entire perimeter of roof area, clamping assembly together. Sarnabar shall have coverstrip hot air welded over it.

E. Recovery / Hard Board:

1. Offset recovery/hard board joints 24 inches minimum from joints in underlying substrate or insulation.
2. On metal or wood deck, secure recovery/hard board using low profile attachment plates and fasteners spaced as required by Membrane Manufacturer's warranty requirements.

F. Membrane:
1. Inspect surface of insulation or substrate before installation of roof membrane. Substrate shall be clean, dry and smooth with no excessive surface roughness, contaminated surfaces or unsound surfaces such as broken, delaminated, or damaged insulation boards.
2. Adhesive:
   a. Apply adhesive using solvent-resistant 3/4 inch 19 mm nap paint rollers. Apply adhesive in smooth, even coating with no holidays, globs, puddles, or similar irregularities. Coat only area that can be completely covered in same day's operations with adhesive. Allow adhesive to dry completely prior to installing membrane.
   b. When adhesive on substrate is dry, roof membrane is unrolled. Overlap adjacent sheets 3 inches 75 mm. Once in place, turn back one-half of sheet's length and coat underside adhesive at rate of 1/2 gal per 100 sq ft 2 liters per 9 sq meters. When adhesive has dried sufficiently to produce strings when touched with dry finger, roll coated membrane onto previously coated substrate being careful to avoid wrinkles. Do not allow adhesive on underside of membrane to dry completely. Amount of membrane that can be coated with adhesive before rolling into substrate will be determined by ambient temperature, humidity, and manpower. Press bonded sheet firmly in place with weighted foam-covered lawn roller by frequent rolling in two directions. Fold back remaining unbonded half of sheet and repeat procedure.
   c. Apply no adhesive in seam areas.
3. Hot-Air Welding Of Lap Areas:
   a. General:
      1) Seams shall be hot air welded. Seam overlaps shall be 3 inches 75 mm wide minimum when automatic machine welding, and 4 inches 100 mm wide when hand welding.
      2) Membrane to be welded shall be clean and dry. No adhesive shall be in seam.
   b. Hand Welding:
      1) Hand welded seams shall be completed in three stages. Allow hot-air welding equipment to warm up for one minute minimum before welding.
      2) Seam shall be tack-welded every 36 inches 900 mm to hold membrane in place.
      3) Weld back edge of seam with narrow but continuous weld to prevent loss of hot air during final welding.
      4) Insert nozzle into seam at 45-degree angle. Once proper welding temperature has been reached and membrane begins to 'flow', position hand roller perpendicular to nozzle and press lightly. For straight seams, use 1-1/2 inch 38 mm wide nozzle. Use 3/4 inch 19 mm wide nozzle for corners and compound connections.
   c. Machine Welding: Follow Roofing Manufacturer's instructions and use recommended equipment.
   d. Quality Control of Welded Seams: Check welded seams for continuity using rounded screwdriver. Make on-site evaluation of welded seams daily at locations directed by Owner's Representative or representative of Roofing Manufacturer. Take one inch 25 mm wide cross-section samples of welded seams at least three times a day. Patch each test cut at no additional cost to Owner.

G. Walkway Pads:
1. Mark lines on membrane to determine location and direction(s) of walkway network. Membrane surface shall be clean.
2. Apply one gallon one liter per 100 lineal ft 8 lineal meters of adhesive to back of walkway pad and allow to dry. Do not apply adhesive to back of welding tabs. Apply 1-1/2 gallons 1-1/2 liters per 100 lineal ft 8 lineal meters of adhesive to membrane at a width of 24 inches 600 mm.
3. Turn walkway pads over and place in position into wet / tacky adhesive. Walk on walkway pads to press surfaces together. Heat-weld welding tabs to membrane.

H. Flashings:
1. General:

a. Install flashings concurrently with roof membrane as job progresses. No temporary flashings shall be allowed without prior written approval of Owner's Representative and Roofing Manufacturer. Approval shall only be for specific locations on specific dates.
b. If water is allowed to enter under newly completed roofing, remove and replace affected area no additional cost to Owner.
c. Adhere flashings to compatible, dry, smooth, and solvent-resistant surfaces.

2. Membrane Flashings:
   a. Adhesive Application for Flashings:
      1) Apply adhesive using solvent-resistant 3/4 inch 19 mm nap paint rollers. Apply adhesive in smooth, even coatings with no holidays, globs, or similar irregularities. Coat only area that can be completely covered in same day's operations. Allow surface with adhesive coating to dry completely prior to installing flashing membrane.
      2) When surface is dry, cut flashing membrane to workable length and evenly coat underside with adhesive at rate of 1/2 gal per 100 sq ft 2 liters per 9 sq meters. When adhesive has dried sufficiently to produce strings when touched with a dry finger, roll coated membrane onto previously coated substrate being careful to avoid wrinkles. Do not allow adhesive on underside of membrane to completely dry. Overlap adjacent sheets 3 inches 75 mm. Flashings shall extend 4 inches 100 mm onto roofing membrane. Press bonded sheet firmly in place with hand roller.
      3) Apply no adhesive in seam areas that are to be welded.
   b. Install Sarnastop fastened 12 inches 300 mm on center with acceptable fasteners into structural deck at the base of parapets, walls, and curbs. Also install Sarnastop at the base of tapered edge strips and at transitions, peaks, and valleys according to Roofing Manufacturer's details.
   c. Extend flashings 8 inches 200 mm minimum above roofing level unless otherwise accepted in writing by Owner's representative and Roofing Manufacturer.
   d. Adhere flashing membranes to solvent resistant substrates. Cut interior and exterior corners and miters and hot-air weld into place. No bitumen shall be in contact with membrane.
   e. Mechanically fasten flashing membranes along top edge through tin discs or pre-drilled, galvanized metal strip washers spaced at of 12 inches 300 mm maximum on center.
   f. Terminate flashings according to Roofing Manufacturer's recommended details.
3. Metal Flashings:
   a. Complete metal work in conjunction with roofing and flashings so that watertight condition exists daily.
   b. Install metal to provide adequate resistance to bending and allow for normal thermal expansion and contraction.
   c. Metal joints shall be watertight.
   d. Securely fasten metal flashings into solid wood blocking. Fasteners shall penetrate wood nailer one inch 25 mm minimum.
   e. Airtight and continuous metal hook strips are required behind metal fascias. Fasten hook strips 12 inches 300 mm on center into wood nailer or masonry wall.
   f. Counterflashings shall overlap base flashings 4 inches 100 mm minimum.
   g. Sarnaclad Metal Base Flashings: Space adjacent sheets of Sarnaclad 1/4 inch 6 mm apart. Fasten ends of Sarnaclad metal 6 inches 150 mm on center. Cover joint with 2 inch 50 mm wide aluminum tape. Hot-air weld 4 inch 100 mm wide strip of flashing membrane over joint.
   h. Sarnaclad Metal Edge Flashing: Fasten metal edge flashings with two rows of post-galvanized flat head annular ring nails, 4 inches 100 mm on center staggered. Space adjacent sheets of Sarnaclad metal 1/4 inch 6 mm apart. Cover joint with 2 inch 50 mm wide aluminum tape. Hot-air weld 4 inch 100 mm wide strip of flashing membrane over joint.

I. Temporary Cut-Off:
   1. Construct temporary waterstops to provide 100 percent watertight seal. Make stagger of insulation joints even by installing partial panels of insulation. Carry new membrane into waterstop. Seal waterstop to deck or substrate so water will not travel under new or existing roofing. Seal edge of membrane in continuous heavy application of sealant as described above. When work resumes, cut-out contaminated membrane and dispose of off-site.
   2. If inclement weather occurs while temporary waterstop is in place, provide labor necessary to monitor situation to maintain watertight condition.

3. If water is allowed to enter under newly completed roofing, remove affected area and replace at no additional cost to Owner.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation and delivery to Roofing Manufacturer by Applicator of certification that installation has been performed in accordance with Contract Documents and Roofing Manufacturer's requirements, technical representative of Roofing Manufacturer shall inspect installed roofing system.

3.4 CLEANING

A. Remove demolished material from site daily to legal dumping area legally authorized to receive such materials.

B. Remove roofing waste material from site daily to legal dumping area authorized to receive such material.

C. Site cleanup, including both interior and exterior building areas that have been affected by construction, shall be completed to Owner's satisfaction.

D. Repair landscaped areas damaged by construction activities at no additional cost to Owner.

END OF SECTION

SECTION 07 6210

GALVANIZED STEEL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install miscellaneous flashing, counterflashing, and hold-down clips as described in Contract Documents and not specified to be of other material.

B. Products Supplied But Not Installed Under This Section:
   1. Copings, scuppers, and miscellaneous sheet metal specialties not specified to be of other materials.

C. Related Sections:
   1. Section under 07 5000 heading: Installation of copings, scuppers, and miscellaneous roofing related flashing.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM A 653-02a, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.'
   2. ASTM A 792-03, 'Standard Specification for Steel Sheet, 55 Percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.'
   3. Current SMACNA guidelines.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sheet Metal:
   1. Galvanized iron or steel meeting requirements of ASTM A 653, G 90 or Galvalume steel meeting requirements of ASTM A 792 AZ50, 50 ksi.
      a. 22 ga for hold-down clips.
      b. 24 ga for all other.
   2. Finish:
      a. Metal exposed to view shall have face coating of polyvinyledene Fluoride (PVF_2) Resin-base finish (Kynar 500 or Hylar 5000) containing 70 percent minimum PVF_2 in resin portion of formula. Thermo-cured two coat system consisting of corrosion inhibiting epoxy primer and top coat factory applied over properly pre-treated metal. Reverse side coating shall be thermo-cured system consisting of corrosion inhibiting epoxy primer applied over properly pre-treated metal.
      b. Color as selected by Architect from Manufacturer's standard colors.
   3. Type Two Acceptable Manufacturers:
      a. Copper Sales Inc, Minneapolis, MN www.unaclad.com.
      b. Englert Inc, Perth Amboy, NJ www.englertinc.com.
      c. Fabral, Lancaster, PA www.fabral.com.
      d. Integris Metals, Minneapolis, MN www.integrismetals.com.

e. Metal Sales Manufacturing Corp, Sellersburg, IN www.mtlsales.com.
f. Petersen Aluminum Corp, Elk Grove, IL www.pac-clad.com.
g. Equal as approved by Architect before installation. See Section 01 6200.

B. Sealants: Rubber base type conforming to Fed Spec TC-S-00230.

C. Fasteners:
1. Of strength and type consistent with function.
2. Nails: Hot-dipped galvanized.
3. Screws, Bolts, And Accessory Fasteners: Galvanized or other acceptable corrosion resistant treatment.

2.2 FABRICATION

A. Form accurately to details.

B. Profiles, bends, and intersections shall be even and true to line.

C. Fold exposed edges 1/2 inch to provide stiffness.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install with small, watertight seams.

B. Slope to provide positive drainage.

C. Provide sufficient hold down clips to insure true alignment and security against wind.

D. Provide 4 inch minimum overlap.

E. Allow sufficient tolerance for expansion and contraction.

F. Insulate work to prevent electrolytic action.

3.2 CLEANING

A. Leave metals clean and free of defects, stains, and damaged finish.

END OF SECTION

SECTION 07 7233

ROOF HATCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section:
   1. Roof hatches and scuttles.

B. Related Sections:
   1. Section 06 2001: Installation.
   2. Sections Under 07 6000 Heading: Flashing and Sheet Metal.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Roof Hatch for Ladder Access:
   1. Sizes as shown on Drawings.
   2. Cover:
      a. Cover: 11 ga mill finish (no finish) aluminum.
      b. Cover Lining: 18 ga mill finish (no finish) aluminum cover liner.
      c. Insulate cover with one inch rigid fiberglass.
   3. Curb: Manufacturer's standard aluminum.
   4. Performance Standard: Bilco NB-50.

B. Type One Acceptable Manufacturers:
   1. Babcock-Davis Hatchways Inc, Arlington, MA www.babcock-davis.com.
   2. The Bilco Co, New Haven, CT www.bilco.com.
   3. Dur-Red Products, Cudahy, CA www.dur-red.com.
   4. Milcor, Lima, OH www.milcorinc.com.
   5. Equal as approved by Architect before bidding. See Section 01 6000.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 07 9213

ELASTOMERIC JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install sealants not specified to be furnished and installed under other Sections.
   2. Quality of sealants to be used on Project not specified elsewhere, including submittal, material, and installation requirements.

B. Related Sections:
   1. Furnishing and installing of sealants is specified in Sections specifying work to receive new sealants.

1.2 SUBMITTALS

A. Product Data:
   1. Manufacturer's literature and installation recommendations for each Product.
   2. Schedule showing joints requiring sealants. Show also backing and primer to be used.

B. Quality Assurance / Control: Certificate from Manufacturer indicating date of manufacture.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Handle to prevent inclusion of foreign matter, damage by water, or breakage.

B. Deliver and keep in original containers until ready for use.

C. Do not use damaged or deteriorated materials.

D. Store in a cool place, but never under 40 deg F.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sealants:
   1. Sealants provided shall meet Manufacturer's shelf-life requirements.
   2. Exterior Building Elements:
      a. Joints and cracks around windows.
      b. Aluminum entrance perimeters and thresholds.
      c. Door frames.
      d. Columns.
      e. Louvers.
      f. Wall penetrations.
      g. Connections.
      h. Parapet caps.

i. Other joints necessary to seal off building from outside air and moisture.
j. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
1) Dow Corning:
a) Primer: 1200.
b) Sealant: 791.
2) General Electric:
a) Primer: SS4044.
b) Sealant: Silpruf SCS 2000.
3) Tremco:
a) Primer:
(1) Metal: No. 20.
(2) Other: No. 23.
b) Sealant: Spectrum 1.

3. Exterior Sheet Metal And Miscellaneous:
a. Penetrations in soffits and fascias.
b. Roof vents and flues.
c. Flashings.
d. Gutters.
e. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
1) 791 or 790 by Dow Corning.
2) Sikaflex 15LM by Sika Corp.
3) Tremsil 600 by Tremco.

4. Exterior Concrete:
a. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
1) Joints between building foundations and exterior site concrete:
a) Dow Corning:
(1) Primer: 1200.
(2) Sealant: 790.
b) General Electric:
(1) Primer: SS4044.
(2) Sealant: Silpruf SCS 2000.
2) Expansion joints in retaining walls:
a) Dow Corning:
(1) Primer: 1200.
(2) Sealant: 790.
b) General Electric:
(1) Primer: SS4044.
(2) Sealant: Silpruf SCS 2000.
3) Expansion joints in Portland cement concrete driveways and parking lots:
a) Dow Corning: 888 (NS). 890 (SL) may be used on non-sloping areas.

5. Interior:
a. Inside jambs and heads of exterior door frames.
b. Inside perimeters of windows.
c. Miscellaneous gaps between substrates.
d. Category Four Approved Product. See Section 01 6200 for definitions of Categories.
1) Tub, Tile, And Ceramic Silicone Sealant by Dow Corning.
2) Acrylseal by General Electric.
3) Tremsil 200 by Tremco.

6. Interior At Exposed Masonry Walls:
a. Both sides of interior door frames.
b. Category Four Approved Product. See Section 01 6200 for definitions of Categories.
1) Tub, Tile, And Ceramic Silicone Sealant by Dow Corning.
2) Acrylseal by General Electric.
3) Tremsil 200 by Tremco.

7. Interior Joints Formed By:
a. Countertops and backsplash to wall.
b. Sinks and lavatories to countertops.
c. Termination joints in showers and fonts.
d. Category Four Approved Products. See Section 01 6200 for definitions of Categories.

1) Tub, Tile, And Ceramic Silicone Sealant by Dow Corning.
2) Acrylseal by General Electric.
3) Tremsil 200 by Tremco.

8. Color: As selected by Architect from Manufacturer's standard colors.

B. Backing: Flexible closed cell, non-gassing polyurethane or polyolefin rod or bond breaker tape as recommended by Sealant Manufacturer for joints being sealed.

2.2 MANUFACTURERS

A. Contact Information:
1. Dow Corning Corp, Midland, MI www.dowcorning.com.
2. G E Silicone Products, Waterford, NY www.gesealants.com .
3. Sika Corporation, Lyndhurst, NJ www.sika.com .
4. Tremco, Cleveland, OH www.tremcosealants.com .

PART 3 - EXECUTION

3.1 PREPARATION

A. Surfaces shall be clean, dry, and free of dust, oil, grease, dew, or frost.

B. Apply primer, if required.

C. Joint Backing:
1. Rod for open joints shall be at least 1-1/2 times width of open joint and of thickness to give solid backing. Backing shall fill up joint so depth of sealant bite is no more than 3/8 inch deep.
2. Apply bond-breaker tape in shallow joints as recommended by Sealant Manufacturer.

3.2 APPLICATION

A. Apply sealant with hand-calking gun with nozzle of proper size to fit joints. Use sufficient pressure to insure full contact to both sides of joint to full depth of joint. Apply sealants in vertical joints from bottom to top.

B. Tool joints immediately after application of sealant if required to achieve full bedding to substrate or to achieve smooth sealant surface. Tool joints in opposite direction from application direction, i.e., in vertical joints, from the top down. Do not 'wet tool' sealants.

C. Depth of sealant bite shall be 1/4 inch minimum and 1/2 inch maximum, but never more than one half or less than one fourth joint width.

D. Do not apply calking at temperatures below 40 deg F.

E. Calk gaps between painted or coated substrates and unfinished or pre-finished substrates. Calk gaps larger than 3/16 inch between painted or coated substrates.

3.3 CLEANING

A. Clean adjacent materials, which have been soiled, immediately (before setting) as recommended by Manufacturer.

END OF SECTION

DIVISION 08: OPENINGS

08 1000 DOORS AND FRAMES

08 1213 HOLLOW METAL FRAMES
08 1313 HOLLOW METAL DOORS

08 3000 SPECIALTY DOORS & FRAMES

08 3362 SECTIONAL OVERHEAD DOORS

08 5000 ALUMINUM WINDOWS

08 5240 ALUMINUM FRAMED WINDOW

08 7000 HARDWARE

08 7101 COMMON FINISH HARDWARE REQUIREMENTS
08 7102 HANGING DEVICES
08 7103 SECURING DEVICES
08 7104 OPERATING TRIM
08 7106 CLOSING DEVICES
08 7107 PROTECTIVE PLATES AND TRIM
08 7108 STOPS AND HOLDERS
08 7109 ACCESSORIES

08 8000 GLAZING

08 8100 GLASS GLAZING

08 9000 LOUVERS AND VENTS

08 9120 ARCHITECTURAL FIXED LOUVERS

END OF TABLE OF CONTENTS

SECTION 08 1213

HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section:
   1. Hollow metal frames.

B. Related Sections:

   1. Section 06 2024: Installation.

1.2 REFERENCES

A. Steel Door Institute / American National Standards Institute:
   1. SDI / ANSI A250.11-2002, 'Recommended Erection Instructions for Steel Frames.'

1.3 SUBMITTALS

A. Quality Assurance / Control: Copy of SDI / ANSI A250.11.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Frames:
   1. Cold rolled furniture steel.
      a. Interior & Exterior Frames: 14 ga.
   2. Provide labeled frame to match fire rating of door.
   3. Finish:
      a. Use one of following systems:
         1) Prime surfaces with rust inhibiting primer.
         2) Galvanize.
   4. Anchors: 16 US ga minimum meeting UL or other code acceptable requirements for door rating involved.

2.2 MANUFACTURERS

A. Category One Approved Manufacturers. See Section 01 6200 for definitions of Categories.
   1. Any current member of Steel Door Institute.

2.3 FABRICATION

A. General Requirements:
   1. Frames shall be welded units. Provide temporary spreader on each welded frame.

2. Provide Manufacturer's gauge label for each item.
3. Make breaks, arrises, and angles uniform, straight, and true. Accurately fit corners.

B. Provide mortar guards at strikes and hinges.

C. Anchors:
1. Provide three jamb anchors minimum for each jamb. On hinge side, install one anchor at each hinge location. On strike side, install one anchor at strike level and anchors at same level as top and bottom hinges. Tack weld anchors on frames intended for installation in framed walls.
2. Frames installed before walls are constructed shall be provided with extended base anchors in addition to other specified anchors.
3. Anchor types and configurations shall meet wall conditions.

PART 3 - EXECUTION NA

END OF SECTION

SECTION 08 1313

HOLLOW METAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section:
   1. Hollow metal doors.
   2. Hollow metal fire doors.

B. Related Sections:
   1. Section 06 2024: Door installation.
   2. Section 08 8100: Quality of glass glazing.

1.2 REFERENCES

A. Steel Door Institute:
   1. SDI -100-91, 'Recommended Specifications, Standard Steel Doors And Frames.'

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Doors:
   1. Meet requirements of Steel Door Institute Bulletin SDI-100.
      a. Grade II for interior & exterior doors.
      b. Model 1 Full Flush or Model 2 Seamless designs at Manufacturer's option.
      c. Type F, G, or L as required.
      d. Finish:
         1) Interior & exterior doors galvanized and primed.
   2. Insulation: Insulate doors at exterior of main building sufficient to provide U-value of 0.10 maximum.

2.2 MANUFACTURERS

A. Category One Approved Manufacturers. See Section 01 6200 for definitions of Categories.
   1. Any current member of Steel Door Institute.

2.3 FABRICATION

A. General:
   1. Mortise and reinforce doors for hinges and locks.
   2. Reinforce doors for closers and other surface applied hardware.
   3. Drill and tap on job.
   4. Seams along vertical edges of door need not be filled.
   5. Do not extend hinge cut out full width of door unless fill strip is inserted, weld filled, and ground smooth so no seam appears on back face plate.

6. Double doors shall have overlapping rolled steel astragal.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Label each door as conforming to above required standards.

PART 3 - EXECUTION

3.1 NA

END OF SECTION

SECTION 08 3362

SECTIONAL OVERHEAD DOORS / Motorized

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install sectional overhead doors as described in Contract Documents.

B. Related Sections:
   1. Section 04814: Preparation of masonry opening.
   2. Section 06201: Installation.
   3. Section 09912: Painting.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM A 653-00, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Alloy-Coated (Galvanealled) by the Hot-Dip Process.'

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's product data, roughing-in diagrams, and installation instructions for each type and size of overhead door.
   2. Manufacturer's literature or cut sheet.
   3. Operation and maintenance instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Steel Sections:
   1. Galvanized structural quality carbon steel sheets complying with ASTM A 653 with minimum yield strength of 33,000 psi.
      a. Steel Sheet Thickness: 16 ga.
      b. Exterior Section Face: Flat.
   2. Fabricate sections from single sheet to provide units not more than 24 inches high, and nominal 2 inches deep. Roll horizontal meeting edges to continuous shiplap, rabbeted, or keyed weather seal, with reinforcing flange return.
   3. Enclose open section with 16 gauge galvanized steel channel end stiles welded in place. Provide intermediate stiles, cut to door section profile, spaced at not more than 48 inches on center and welded in place.
   4. Reinforce bottom section with continuous channel or angle conforming to bottom section profile.
   5. Reinforce sections with continuous horizontal and diagonal reinforcing, as required by door width and design wind loading. Provide galvanized steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place.

B. Insulation:
   1. Insulate inner core of steel sections with Door Manufacturer's standard glass fiber, polystyrene, or polyurethane foam type insulation.

2. Enclose insulation with Door Manufacturer's standard steel sheet secured to door panel.

C. Tracks, Supports, And Accessories:
1. Tracks:
   a. Manufacturer's high vertical lift galvanized steel track system, sized for door size and weight, and designed for clearances shown.
   b. Provide complete track assembly including brackets, bracing and reinforcing for rigid support of ball bearing roller guides, for required door type and size.
   c. Slot vertical sections of track at 2 inches on center for door drop safety device.
   d. Slope tracks at proper angle from vertical, or otherwise design to ensure tight closure at jambs when door unit is closed.
   e. Weld or bolt to track supports.
2. Track Reinforcement And Supports:
   a. Galvanized steel track reinforcement and support members.
   b. Secure, reinforce and support tracks as required for size and weight of door to provide strength and rigidity, and to ensure against sag, sway, and detrimental vibration during opening and closing of doors.
   c. Support and attach tracks to opening jambs with continuous angle welded to tracks and attached to wall.
   d. Support horizontal (ceiling tracks) with continuous angle welded to track and supported by laterally-braced attachments to overhead structural members at curve and end of tracks.
3. Weather Seals: Continuous rubber, neoprene, or flexible vinyl adjustable weather-strip gasket at tops and compressible astragal on bottoms of each overhead door.
4. Vision Panels:
   a. Clear float glass vision panels in arrangement shown on Drawings.
   b. Set glass in rubber or neoprene channel glazing strips.
   c. Provide removable stops of same material as door section frames.

D. Hardware:
1. Heavy-duty, rust-resistant hardware, with stainless steel fasteners, to suit type of door.
2. Hinges:
   a. Heavy steel hinges at each end stile and at each intermediate stile, in accordance with Manufacturer's recommendations for size of door.
   b. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts.
   c. Use rivets or self-tapping fasteners where access to nuts is not possible.
   d. Provide double-end hinges, where required, for doors exceeding 16 feet in width, unless otherwise recommended by Door Manufacturer.
3. Rollers:
   a. Heavy-duty rollers, with steel ball bearings in case-hardened steel races, mounted with varying projections to suit slope of track.
   b. Extend roller shaft through both hinges where double hinges are required.
   c. Provide case-hardened steel roller tires to suit size of track.

E. Counterbalancing Mechanisms:
1. Extension Spring:
   a. Hang door assembly for operation by extension spring counterbalance mechanism with aircraft type steel cable over ball-bearing sheaves.
   b. Oil tempered wired springs with internal safety rods.

F. Electric Door Operators:
1. UL listed and labeled electric door operator assembly complete with 1/3 horse power, 208 V, single phase electric motor and factory-prewired motor controls, gear reduction unit, solenoid operated brake, clutch, remote control stations and control devices.
2. Hand-operated disconnect or mechanism for automatically engaging sprocket chain operator and releasing brake for emergency manual operation. Include interlock device to automatically prevent motor from operating when emergency sprocket is engaged.
3. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.

4. Door Operator Type:
   a. Jack shaft type, with clutch-disconnect release for manual operation, V-belt and roller chain drive connected to counter-balance shaft.
   b. Side mount with V-belt and roller chain drive connected to counterbalance shaft, and with auxiliary chain hoist and disconnect switch.
   c. Remote Control Station: Momentary-contact, 3-button control station with push button controls labeled OPEN, CLOSE, and STOP.
5. Automatic Reversing Control:
   a. Furnish each door with automatic safety switch, extending full width of door bottom, and located within neoprene or rubber astragal mounted to bottom door rail.
   b. Contact with switch will immediately reverse downward door travel.
   c. Furnish Door Manufacturer's standard take-up reel or self-coiling cable.
   d. Provide pneumatically actuated automatic bottom bar.

2.2 APPROVED MANUFACTURERS

A. Contact Information:
   1. Clopay Overhead Door Co, Russia, OH (800) 526-4301 or (513) 762-3955. www.clopay.com
   2. Overhead Door Corp, Dallas, TX (800) 441-6847 or (972) 233-6611. www.overheaddoor.com
   3. Raynor Garage Doors, Dixon, IL (800) 472-9667 or (815) 288-1431. www.raynor.com
   4. Windsor Door, Little Rock, AR (800) 946-3767 or (501) 562-1872. www.windsordoor.com

2.3 FINISH

A. Apply Door Manufacturer's standard prime coat, applied to both door faces after forming.

B. Prime finish door sections with one coat of alkyd base exterior primer, applied to provide minimum one mil dry film thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install door, track, and operating equipment complete with necessary hardware, jamb and head mold stops, anchors, inserts, hangers, and equipment supports.

B. Fasten vertical track assembly to framing at 24 inches on center maximum.
   1. Hang horizontal track from structural overhead framing with angle or channel hangers, welded and bolt-fastened in place.
   2. Provide sway bracing, diagonal bracing, and reinforcing as required for rigid installation of track and door operating equipment.

3.2 ADJUSTING

A. Upon completion of installation, lubricate, test and adjust doors to operate easily, free from warp, twist, or distortion and fitting weather tight for entire perimeter.

END OF SECTION

SECTION 08 5240

ALUMINUM FIXED WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install windows, including glazing, as described in Contract Documents.

B. Related Sections:
   1. Section 07920: Quality of sealants.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM B 22l-95a, 'Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.'

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's literature or cut sheet.
   2. Literature on glazing provided.
   3. Maintenance and re-glazing instructions.

B. Shop Drawings: Submit before framing walls. Show rough opening requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Windows shall be preassembled, including glass, at factory and shipped as unitized system.
   2. Properly crate or package individual units to protect from damage to frame and breakage of glass during shipping.

B. Storage:
   1. Store widows as directed by Architect in enclosed area and off ground.
   2. Protect stored window units from damage by other construction materials and activities.

C. Handling:
   1. Uncrate and handle windows in such manner that frames and finish are not damaged or marred and so glass is not cracked or broken.
   2. During installation, handle window frames in manner to avoid damage or marring of metal or finish and to avoid breakage of glass.
   3. Replace damaged or broken windows at no additional cost to Owner.

1.5 WARRANTY

A. Guarantee work against defective materials or workmanship for two years following acceptance of materials by Architect.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Window Frames:
   1. Aluminum: 6063-T5 aluminum alloy or meeting requirements of ASTM B 221, alloy GS 10A-T5.
   2. Webs: Glass fiber reinforced polyamide.
   3. Fasteners: Non-magnetic stainless steel. Concealed fastenings shall be cadmium or zinc-plated steel.
   4. Construction:
      a. Insulated thermally broken frame with extruded aluminum outer and inner frame members separated by synthetic material webs enclosing insulated core.
      b. Webs attached to inner and outer aluminum extrusions without use of screws, bolts, rivets, or adhesives.
   5. Finish:
      a. Aluminum Association AA-M21C22A41 clear natural anodized (AAMA 608.1).

B. Glazing:
   1. Interior Window Glazing: Clear – insulated tempered glass.
   2. Exterior Window Glazing: Clear interior pane and Clear exterior pane with Low E treatment on surface 2. Tempered glass.
   3. Manufacturers:
      a. Kawneer North America
      b. Vistawall Group

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work: Coordinate installation steel with masonry and stone work to ensure frames are properly attached and anchored.

B. Windows shall be installed by experienced workmen in accordance with Manufacturer's instructions.

C. Set plumb, square, level in correct alignment, and securely anchor.

D. Caulk joints between frames and walls, both interior and exterior.

3.2 CLEANING

A. After installation, clean interior and exterior metal surfaces of windows, panels, and entrances.

END OF SECTION

SECTION 08 7101

GENERAL HARDWARE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Related Sections
   1. Division 06 -
      a. Architectural woodwork hardware
      b. Installation

1.2 DEFINITIONS

A. Builders Hardware Manufacturer's Association (BHMA) Hardware Functions
   1. F-75 Passage Latch - Latch bolt operated by knob / lever from either side at all times.
   2. F-76 Privacy Lock - Latch bolt operated by knob / lever from either side. Outside knob / lever locked by push button inside and unlocked by emergency key from outside or rotating knob / lever from inside.
   3. F-81 Office Door Lock - Dead locking latch bolt operated by knob / lever from either side, except when outside knob / lever is locked by turn button in inside knob/lever. When outside knob / lever is locked, latch bolt is operated by key in outside knob/lever or by rotating inside knob / lever. Turn button must be manually rotated to unlock outside knob / lever.
   5. F-86 Utility Space Door Lock - Dead locking latch bolt operated by key in outside knob / lever or by rotating inside knob / lever. Outside knob / lever is always fixed.
   6. F-89 Exit Door Lock - Deadlocking latch by lever inside. Outside always locked.
   7. F-81 Entry Door Lock – Deadlocking latch bolt by lever either side except when outside locked by turn button inside. When outside locked, key outside, or lever inside, opens lock. Turn button operated manually.

1.3 SUBMITTALS

A. Product Data
   1. Manufacturer's cut sheets
   2. Two copies of Manufacturer’s installation, adjustment, and maintenance instructions for each piece of hardware. Include one set in Operations And Maintenance M Manual and send one set with hardware when delivered.
   3. Copy of hardware schedule
   4. Written copy of keying system explanation. Keying information shall include high security keyway supplier's name, address, and phone number.
   5. Instructions for re-keying from Church approved high security keyway supplier.
   6. Copy of authorized signature card for rekeying.

B. Shop Drawings - Submit hardware schedule indicating hardware to be supplied. Schedule shall indicate details such as proper type of strikeplates, spindle lengths, hand, backset, and bevel of locks, hand and degree opening of closer, length of kickplates, length of rods and flushbolts, type of door stop, and other necessary information necessary to determine exact hardware requirements.

C. Quality Assurance / Control - Certificate or letter signed by hardware supplier and by Contractor stating that hardware provided is same as that specified in Contract Documents.

D. Closeout - Submit keying plan and bitting schedule as record documents.

1.4 QUALITY ASSURANCE

A. Suppliers bidding this work shall have two years minimum experience in providing, detailing,

scheduling, and installing builders hardware and shall employ at least one full time DHI Architectural Hardware Consultant (AHC).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Neatly and securely package hardware items by hardware group and identify for individual door with specified group number and set number used on Supplier's hardware schedule. Include fasteners and accessories necessary for installation and operation of finish hardware in same package.

1.6 SCHEDULING

A. Hardware Templates
   1. Provide hardware templates to Sections 08100 and 08200 within 14 days after hardware schedule is approved by Architect.
   2. Supply necessary hardware installation templates to Division 06 prior to pre-installation meeting.

PART 2 PRODUCTS

2.1 FINISHES

A. Finishes for steel, brass, or bronze hardware items shall be US26D, Chromium plated, satin, except flat goods which may be US32D, stainless steel, satin. Materials other than steel, brass, or bronze shall be finished to match the appearance of US26D / 32D.

2.2 FASTENERS

A. Fasteners shall be of suitable types, sizes and quantities to properly secure hardware. Fasteners shall be of same material and finish as hardware unless otherwise specified. Fasteners exposed to weather shall be non-ferrous or corrosion resisting steel.

PART 3 EXECUTION

3.1 PREPARATION

A. Before ordering materials, examine documents to be assured that material to be ordered is appropriate for substrate to which it is to be secured and will function as intended.

3.2 HARDWARE GROUP SCHEDULE

A. Single Exterior Doors

Group 1 -	Door No's 1, 2, 3
3 each	- Hinges
1 each	- Exit Device with cylinder and capable of dogging
1 each	- Lockset Function F-89
1 each	- Closer
1 each	- Threshold
1 set	- Weatherstripping

B. Exterior Double Doors

Group 2 - Door No's 4

1. General -
   - 1 each - Threshold
   - 1 set - Weatherstripping
2. Inactive Leaf -
   - 3 each - Hinges
   - 1 each - Stop and Holder
   - 2 each - Automatic Flushbolts
   - ! each - Pull
   - 1 each - Closer
3. Active Leaf -
   - 3 each - Hinges
   - 1 each - Lockset Function F-89
   - 1 each - Stop and Holder
   - 1 each - Closer

C. Single Interior Doors

Group 3 - Door No's 5

- 3 each - Hinges
- 1 each - Latchset Function F-81
- 1 each - Stop
- 1 set - Silencers

Group 4 - Door No's 6

- 3 each - Hinges
- 1 each - Latchset Function F-75
- 1 each - Stop
- 1 each - Stop/Holder
- 1 each - Closer
- 1 each - Smoke Gasket

Group 5 - Door No's 7

- 3 each - Hinges
- 1 each - Lockset Function F-76
- 1 each - Closer
- 1 each - Stop
- 1 each - Stop/Holder
- 1 set - Sound Gaskets
- 1 each - Kick plate

D. Double Interior Doors

Group 6 - Door No's 8

1. General -
   - 2 sets - Smoke Gaskets
2. Inactive Leaf -
   - 3 each - Hinges
   - 2 each - Flushbolts

1 each - Stop & Holder

3. Active Leaf -
   - 3 each - Hinges
   - 1 each - Lockset Function F-86
   - 1 each - Stop - Overhead

END OF SECTION

SECTION 08 7102

HANGING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:
   1. Hinges for hollow metal doors.

B. Related Requirements:
   1. Section 08 7101: Common Hardware Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Hager Companies, St Louis, MO www.hagerhinge.com.
      b. Ives, New Haven, CT www.iveshardware.com.
      c. McKinney, Scranton, PA www.mckinneyhinge.com.
      d. PBB, Ontario, CA www.pbbinc.com.
      e. Stanley, New Britain, CT www.stanleyworks.com.

B. Hinges:
   1. Sizes:
      a. 1-3/4 inch doors in metal frames:
         1) Standard: 4-1/2 inches by 4-1/2 inches.
         2) Wide Throw: 4-1/2 inches by width required.
   2. Use non-removable pins on exterior opening doors.
   3. Hinges on exterior doors shall be solid brass, plated to achieve specified finish.
   4. Approved Products.
      a. Interior:
         1) Hager: BB 1279.
         2) Ives: 5BBI.
         3) McKinney: TA 2714.
         4) MacPro / McKinney: MPB79
         5) PBB: BB81.
         6) Stanley: FBB 179.
      b. Exterior:
         1) Hager: BB 1191.
         2) Ives: 5BBI.
         3) McKinney: TA 2314.
         4) PBB: BB21.
         5) Stanley: FBB 191.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 08 7103

SECURING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:
   1. Items for architectural wood or hollow metal doors:
      a. Flush bolts.
      b. Locksets and latchsets.
      c. Cylinders.
      d. Interior exit devices.

B. Related Requirements:
   1. Section 08 7101: Common Hardware Requirements.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Standard Key Delivery:
   1. Include change keys with hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:
   1. Manufacturer List:
      a. Corbin Russwin, Berlin, CT www.corbinrusswin.com.
      b. Glynn-Johnson, Indianapolis, IN www.glynn-johnson.com.
      c. Hager, St Louis, MO www.hagerhinge.com.
      d. Ives, New Haven, CT www.iveshardware.com.
      e. Knape & Vogt, Grand Rapids, MI www.knapeandvogt.com.
      f. Master Lock, Oak Creek, WI.
      g. Precision Hardware, Romulus, MI www.precisionhardware.com.
      h. Rockwood, Manufacturing Co, Rockwood, PA www.rockwoodmfg.com.
      i. Sargent, New Haven, CT www.sargentlock.com.
      j. Schlage, Colorado Springs, CO www.schlage.com.
      k. Von Duprin, Indianapolis, IN www.vonduprin.com.

B. General:
   1. Backsets shall be 2-3/4 inches.
   2. Furnish lead shields where required.

C. Flush Bolts:
   1. Acceptable Products:

      a. Manual Flushbolts:
         1) Hager 282D
         2) Ives FB458
         3) Rockwood 555
      b. Automatic Flushbolts:
         1) Hager 293D

2) Ives FB31P
3) Rockwood 1845

c. Equal as approved by Architect before installation. See Section 01 6200.

D. Locksets And Latchsets:
1. Lever Operated:
a. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
1) 9K Heavy Duty Lever Series by Best Access Systems

E. Standard Cylinders:
1. Provide cylinders for interior exit devices requiring cylinders.
2. Approved Products. See Section 01 6200 for definitions of Categories.
a. Match Manufacturer of locksets.
3. Other Cylinders: Provide cylinders for overhead doors, and for interior exit devices requiring cylinders.
4. Approved Products. See Section 01 6200 for definitions of Categories.
a. Match Manufacturer of locksets.

F. Exit Devices:
1. Use operable lever trim.
2. Provide labeled hardware where required by local code authority.
3. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a. Apex Series by Precision.
b. 80 Series by Sargent.
c. 99 or 98 Series by Von Duprin.

PART 3 - EXECUTION

3.1 CLOSE-OUT ACTIVITIES

A. Before Final Acceptance Meeting, send master keys to Owner representative.

END OF SECTION

SECTION 08 7104

OPERATING TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:
   1. Interior push / pulls.

B. Related Requirements:
   1. Section 08 7101: Common Hardware Requirements and VMR Suppliers.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Standard Door Push / Pulls:
   1. Size: 15 by 3-1/2 inches.
   2. Type Two Acceptable Products:
      a. PS3515, PL3515 / 80301 by Glynn-Johnson, Indianapolis, IN www.glynn-johnson.com.
      b. 39E, 30S by Hager, St Louis, MO www.hagerhinge.com.
      c. 8200, 8302 by Ives, Wallingford, CT www.iveshardware.com.
      d. 70B, 105x70B by Rockwood Manufacturing Co, Rockwood, PA www.rockwoodmfg.com.
      e. Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 08 7106

CLOSING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:
   1. Closers for hollow metal doors.

B. Related Requirements:
   1. Section 08 7101: Common Hardware Requirements:

1.2 SUBMITTALS

A. Closeout Submittals:
   1. Operations And Maintenance Data: Include final, executed copy of warranty in Operations and Maintenance Manual specified in Section 01 7800.

1.3 WARRANTY

A. Manufacturer's standard warranty, 5 years minimum.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:
   1. Approved Manufacturers.
      a. 7900 Series by Dorma Architectural Hardware, Reamstown, PA www.dorma.com/usa.
      b. 1461 Series by LCN Closers, Princeton, IL www.lcnclosers.com.
      c. 8501 Series by Norton Door Controls, Charlotte, NC www.nortondoorcontrols.com.
      d. 1431 Series by Sargent, New Haven, CT www.sargentlock.com.

B. Surface-Mounted Overhead Door Closers:
   1. Closers provided under this Section shall be from same Manufacturer.
   2. Provide parallel arms on closers unless door position in relation to adjacent wall requires otherwise. Provide covers.
   3. Closers shall allow for 180 degree opening and not be used as a stop.
   4. Closers shall have following features:
      a. Adjustable sweep speed.
      b. Adjustable backcheck.
      c. Non-handed, non-sized.

PART 3 - EXECUTION

3.1

3.2 INSTALLATION

A. Mount closers on stop side of door wherever conditions permit.

B. Through-bolt hardware-to-door connections.

3.3 ADJUSTING

A. Adjust closers to provide maximum opening force as required by governing code authority and proper backcheck and sweep speed.

END OF SECTION

SECTION 08 7107

PROTECTIVE PLATES AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:
   1. Kick plates.

B. Related Requirements:
   1. Section 08 7101: Common Hardware Requirements and VMR Suppliers.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:
   1. Type Two Acceptable Manufacturers:
      a. Glynn-Johnson, Indianapolis, IN www.glynn-johnson.com.
      b. Hager, St Louis, MO (800) 255-3590 or (314) 772-4400 www.hagerhinge.com.
      c. Ives, Wallingford, CT www.iveshardware.com.
      d. Rockwood Manufacturing Co, Rockwood, PA www.rockwoodmfg.com.
      e. Equal as approved by Architect before installation. See Section 01 6200.

B. Protective Plates:
   1. Material: 0.050 inch thick Stainless Steel.
   2. Sizes:
      a. Kick Plates: 10 inches high by width of door less 3/4 inch on each side.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 08 7108

STOPS AND HOLDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Products Supplied But Not Installed Under This Section:
   1. Door stops.
   2. Door stops and holders.

B. Related Sections:
   1. Section 08 7101: Common Hardware Requirements.

1.2 MANUFACTURED UNITS

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Corbin Russwin, Berlin, CT www.corbinrusswin.com.
      b. Glynn-Johnson, Indianapolis, IN www.glynn-johnson.com.
      c. Hager, St Louis, MO www.hagerhinge.com.
      d. Ives, Wallingford, CT www.iveshardware.com.
      e. Rockwood Manufacturing Co, Rockwood, PA www.rockwoodmfg.com.
      f. Sargent, New Haven, CT (800) 906-6606 or (203) 562-2151 www.sargentlock.com.

B. Stops:
   1. Use wall type stops unless indicated otherwise on Door Schedule.
   2. Provide model appropriate for substrate. Wall stops may be either cast or wrought.
   3. Acceptable Products:

		Interior Wall	Overhead.
a.			
b.	Hager	236W	- - -
c.	Ives	WS407CCV	- - -
d.	Rockwood	409	- - -
e.	Corbin Russwin	- - -	DH5203 Series
f.	Glynn Johnson	- - -	GJ 90S
g.	Sargent	- - -	590S Series

      h. Equal as approved by Architect before Installation. See Section 01 6200.

C. Door Stops And Holders:
   1. Acceptable Products:
      a. Hager: 268F, 268S or 256S, 256W.
      b. Ives: WS444, WS449, FS446, FS450.
      c. Rockwood: 472, 473, 476, 477.
      d. Equal as approved by Architect before Installation. See Section 01 6200.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Interface With Other Work: When using overhead stops, coordinate installation with door closer and other door hardware.

SECTION 08 7109

ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:
   1. Metal thresholds where required for hollow metal doors.
   2. Weatherstripping for exterior hollow metal doors.
   3. Acoustical seals.
   4. Smoke gaskets.

B. Related Requirements:
   1. Section 08 7101: Common Hardware Requirements.
   2. Section 09 3005: Stone thresholds.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:
   1. Manufacturer List:
      a. Hager, St Louis, MO www.hagerhinge.com.
      b. Ives, Wallingford, CT www.iveshardware.com.
      c. NGP - National Guard Products, Memphis, TN www.ngpinc.com.
      d. Pemko Manufacturing, Ventura, CA www.pemko.com.

B. Thresholds:
   1. Type One Acceptable Products:
      a. Out swinging Exterior Doors, Approved Products:
         1) 560SV by Hager.
         2) 891V by NGP.
         3) 185AV by Pemko.
      b. Equals as approved by Architect before bidding. See Section 01 6200.

C. Weatherstripping:
   1. Acceptable Products:
      a. Perimeter:
         1) 800S by Hager.
         2) A625A by NGP.
         3) 35041CP by Pemko.
      b. Bottom:
         1) Equal by Hager.
         2) 198NA by NGP.
         3) Equal by Pemko.
      c. Equal as approved by Architect before bidding. See Section 01 6200.

D. Acoustical Seals:
   1. Color as selected by Architect.
   2. Acceptable Products:
      a. Door Bottom for Metal Door:
         1) 779S-A by Hager.
         2) 35EV by NGP.

3) 217AV by Pemko.

b. Equal as approved by Architect before bidding. See Section 01 6200.

E. Smoke Gaskets:

1. Color as selected by Architect.
2. Acceptable Products:
   a. 726 by Hager.
   b. 5050 by NGP.
   c. PK55 by Pemko.
   d. Equal as approved by Architect before bidding. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install smoke gaskets and acoustical seals in manner to give continuous air-tight fit.

1. Install smoke gaskets in 'wipe seal' configuration.

END OF SECTION

SECTION 08 8100

GLASS GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of glazing used in entries, doors, and windows.

B. Related Sections:
   1. Sections Under 08 1000 Heading: Furnishing and installing of glazing for hollow metal doors and hollow metal sidelite windows.
   2. Sections Under 08 1000 Heading: Furnishing and installing of flush wood door lites.
   3. Section 08 5113 or 08 5313: Furnishing and installing of glazing in windows.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM C 1036-01, 'Standard Specification For Flat Glass.'
   2. ASTM C 1048-04, 'Standard Specification For Heat-Treated Flat Glass - Kind H, Kind FT Coated and Uncoated Glass.'
   3. ASTM E 774-97, 'Standard Specification for Sealed Insulating Glass Units.'

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Glazing shall meet applicable requirements of Federal Consumer Product Safety Standard 16CFR1201.

B. Manufacturer's Labels: Labels showing strength, grade, thickness, type, and quality are required on each piece of glass.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Exterior Window Glazing:
   1. Thickness: 1/8 inch minimum, Double Strength.
   2. Glazing shall have following characteristics:
      a. Clear: ASTM C 1036, Type I, Class I, Quality q3.
      b. Pyrolytic Low E:
         1) Performance Standard: Energy Advantage Clear by LOF.
         2) Type One Acceptable Manufacturers:
            a) AFG
            b) LOF
            c) PPG
            d) Visteon.

e) Other low E glazing system standard with window manufacturer that meets or exceeds performance characteristics of specified glazing is acceptable as approved by Architect before bidding. See Section 01 6200.

c. Glazing in windows within 24 inches of exterior doors shall be tempered meeting requirements of ASTM C 1048, Kind FT, Condition A, Type I, Class I, Quality q3.

B. Storefront / Exterior Door Glazing:
1. Thickness: 1/4 inch.
2. Glazing shall have following characteristics:
a. Clear: ASTM C 1036, Type I, Class I, Quality q3.
b. Pyrolytic Low E:
1) Performance Standard: Energy Advantage Clear by LOF.
2) Type One Acceptable Manufacturers:
a) AFG
b) LOF
c) PPG
d) Visteon.
e) Equal as approved by Architect before bidding. See Section 01 6200.
c. Obscure: ASTM C 1036, Type II, Class I, Form 3, Quality q8, Pattern - #62.
d. Glazing below door height shall be tempered meeting requirements of ASTM C 1048, Kind FT, Condition A, Type I, Class I, Quality q3.

C. Miscellaneous Glazing:
1. Interior Door Lites:
a. Thickness: 1/4 Inch.
b. Tempered glazing meeting requirements of ASTM C 1048, Kind FT, Condition A, Type I, Class I, Quality q3.

2.2 MANUFACTURERS

A. Contact Information for Low E Glazing Manufacturers:
1. AFG Industries, Kingsport, TN www.afg.com.
2. Pilkington Libby-Owens-Ford - LOF, Toledo, OH www.pilkington.com.
3. PPG Industries, Pittsburgh, PA www.ppgglass.com.
4. Visteon, Allen Park, MI www.visteon.com/floatglass/

2.3 FABRICATION

A. Except where glass exceeds 66 inches in width, cut clear glass so any wave will run horizontally when glazed.

B. Install muntins for exterior aluminum entries and aluminum windows between panes of insulating glazing units. No muntins on interior Vestibule storefront entries.

C. Sealed, Insulating Glazing Units:
1. Double pane, sealed insulating glass units meeting requirements of ASTM E 774, Class A. Install at exterior windows and exterior aluminum-framed storefront.
2. Unit Thickness: 5/8 inch minimum, one inch maximum.
3. Insulated obscure units shall consist of one pane of specified obscure glass and one pane of standard glass.
4. Type Seal:
a. Metal-to-glass bond and separated by 1/2 inch dehydrated air space.
b. Use non-hardening sealants.
5. Category Four Approved Fabricators. See Section 01 6200 for definitions of Categories.
a. Members of Sealed Insulating Glass Manufacturer's Association.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 08 9120

ARCHITECTURAL FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:
   1. Aluminum architectural louvers.

B. Related Requirements:
   1. Section 04 2723: Installation in multiple-wythe masonry.
   2. Section 06 2001: Installation in framing and brick veneer masonry.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Acceptable Manufacturers:
   1. Airolite, Marietta, OH www.airolite.com.
   2. American Warming & Ventilating, Holland, OH www.american-warming.com.
   3. Arrow United Industries, Wyalusing, PA www.arrowunited.com.
   4. Carnes, Verona, WI www.carnes.com.
   5. Industrial Louvers, Delano, MN www.industriallouvers.com.
   6. Ruskin Manufacturing, Grandview, MO www.ruskin.com.
   7. Vent Products, Chicago, IL www.ventprod.com.
   8. Wonder Metals Corp, Redding, CA www.wondermetals.com.
   9. Equal as approved by Architect before bidding. See Section 01 6200.

B. Weather-Proof Wall Louvers:
   1. 6063 T5 aluminum.
   2. Metal thickness minimum:
      a. 0.050 inch Louvers up to 24 inches square.
      b. 0.081 inch Louvers over 24 inches either dimension.
   3. Flange type frame.
   4. Louvers shall be sloped and shaped to prevent penetration of driving rains or snow.
   5. Screens: 14x18 aluminum mesh.
   6. Finish:
      a. Mill finish, with clear Methacrylate lacquer protection.
      b. Kynar 500 or Hylar 5000, color as selected by Architect.
      c. Class Two Quality Standard: K638 by Airolite

PART 3 - EXECUTION: Not Used

END OF SECTION

DIVISION 09: FINISHES

09 2000 PLASTER AND GYPSUM BOARD

09 2216 NON-STRUCTURAL METAL FRAMING
09 2900 GYPSUM BOARD

09 3000 TILING

09 3005 TILE SETTING MATERIALS AND ACCESSORIES
09 3013 CERAMIC TILING

09 5000 CEILINGS

09 5113 ACCOUSTICAL PANEL CEILINGS
09 5323 METAL ACCOUSTICAL SUSPENSION ASSEMBLIES

09 9000 PAINTS AND COATINGS

09 9001 COMMON PAINTING AND COATING REQUIREMENTS
09 9113 INTERIOR AND EXTERIOR PAINTED METAL
09 9121 INTERIOR PAINTED CONCRETE
09 9122 INTERIOR PAINTED CMU
09 9123 INTERIOR PAINTED GYPSUM BOARD, PLASTER
09 9124 INTERIOR PAINTED METAL
09 9321 INTERIOR SEALED CONCRETE FLOORS
09 9413 INTERIOR TEXTURED FINISHING

END OF TABLE OF CONTENTS

SECTION 09 2216

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install metal framing and furring systems and blocking as described in Contract Documents.

B. Related Sections:
   1. Section 05 4010: Load-bearing metal framing.
   2. Section 06 1100: Wood blocking.
   3. Section 09 2226: Furring on suspended ceilings.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM C 645-04, 'Standard Specification for Nonstructural Steel Framing Members.'

1.3 SUBMITTALS

A. Shop Drawings: Show special components and installations not fully dimensioned or detailed in Manufacturer's Product data.

B. Quality Assurance / Control:
   1. Manufacturer's technical product data, installation instructions, and recommendations for each component of system.
   2. ICBO Evaluation Report:

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: ICBO approved.

B. Pre-Installation Conference: Schedule pre-installation conference to be held after submittals have been reviewed and returned by Architect, but before beginning metal framing work. Identify location of required blocking.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Framing:
   1. 20 ga minimum, unless noted greater on Drawings, meeting requirements of ASTM C 645.
   2. Tracks, bridging, blocking, strapping, and other accessories shall be as described in Contract Documents or as required by Manufacturer's system.
   3. Type One Acceptable Products:

a. 3-5/8 IC 20 ga by American Studco.
b. 362DS20P by CEMCO.
c. Drywall Metal, 20 ga only, by Clark Western.
d. 20 Ga STE by Dietrich Industries.
e. 20 Ga 3-5/8 SS Series by Steeler Inc.
f. Any member of Steel Stud Manufacturer's Association (SSMA).
g. Equal as approved by Architect before bidding. See Section 01 6200.

B. Furring Channels:
1. Hat Shaped Channels: Roll formed from DWC-25 corrosion resistant steel in sizes shown on Drawings.
2. 'Z' Shaped Channels: 20 ga minimum galvanized steel in sizes shown on Drawings.

C. Sheet Steel: 18 ga hot-dipped galvanized sheet steel.

D. Sill Sealer: Closed-cell polyethylene foam, 1/4 inch thick by width of plate.

2.2 MANUFACTURERS

A. Contact Information:
1. Allied Studco Inc, Phoenix, AZ www.studco.com.
2. CEMCO, City of Industry, CA www.cemcosteel.com.
3. Clark Western, Cincinnati, OH www.clarksteel.com.
4. Dietrich Industries Inc, Pittsburgh, PA www.dietrichindustries.com.
5. Steeler Inc, Seattle, WA www.steeler.com.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Specifications of Stud Wall Manufacturer shall govern this work unless more stringent requirements are required by Contract Documents.

B. Interface With Other Work:
1. Coordinate with other Sections to provide blocking necessary for their work.
2. Coordinate with other Sections for location of blocking required for installation of equipment and building specialties.

C. Wall Tolerances:
1. 1/4 inch in 20 feet, non-cumulative in length of wall.
2. 1/8 inch in 10 feet with 1/4 inch maximum in height of wall.
3. Distances between parallel walls shall be 1/4 inch maximum along length and height of wall.

D. Framing:
1. Install specified sill sealer under sill plates of exterior walls and of acoustically insulated interior walls.
2. Stiffen 4 inch metal-framed walls with 3/4 inch cold-rolled channels placed horizontally approximately 48 inches from floor and securely attach to each stud. Stiffen 6 inch or larger metal-framed walls same as above, except install one set of channels on each side of framing members.
3. Similarly reinforce door and window openings at headers with reinforcing channel extending 18 inches minimum each side of opening.
4. Apply double framing members at openings. Wrap multiple, adjacent framing members with duct tape or otherwise secure to eliminate 'chattering.'
5. Use grommets at framing penetrations where unsecured items pass through.

END OF SECTION

SECTION 09 2900

GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install gypsum board as described in Contract Documents, except behind ceramic tile.
   2. Furnish and install acoustical sealants as described in Contract Documents.

B. Related Sections:
   1. Section 07 9219: Quality of acoustical sealants.
   2. Section 09 3005: Backerboard behind ceramic tile.
   3. Section 09 9413: Textured finishing

1.2 REFERENCES

A. Gypsum Association:
   1. GA-214-90: 'Recommended Specification: Levels of Gypsum Board Finish.'

B. American Society For Testing And Materials:
   1. ASTM C 36-03, 'Standard Specification for Gypsum Wallboard.'
   2. ASTM C 475-02, 'Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.'
   3. ASTM C 840-01, 'Standard Specification for Application and Finishing of Gypsum Board.'
   4. ASTM C 931-02, 'Standard Specification for Exterior Gypsum Soffit Board.'
   5. ASTM C 1002-01, 'Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panels or Metal Plaster Bases to Wood Studs or Steel Studs.'
   6. ASTM C 1396-04, 'Standard Specification for Gypsum Board.'

1.3 SUBMITTALS

A. Quality Assurance / Control: Fire test results or assembly diagrams and numbers confirming products used will provide required fire ratings with installation configurations used.

1.4 QUALITY ASSURANCE

A. Pre-Installation Conference:
   1. Not required.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name, applicable standard designation, and Manufacturer's name.

B. Store material under roof and keep dry. Stack gypsum board flat and protect from damage.

1.6 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Temperature shall be 50 deg F and 95 deg F maximum day and night during entire joint operation and until execution of Certificate of Substantial Completion.
   2. Provide ventilation to eliminate excessive moisture.
   3. Avoid hot air drafts that will cause too rapid drying.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Interior Gypsum Board:
   1. Fire-Rated Construction:
      a. Class Two Quality Standard: Product meeting requirements of ASTM C 36, C 1396, Type X, UL one-hour rated, tapered edge, face paper suitable for painting.
   2. Non-Fire-Rated Construction:
      a. Class Two Quality Standard: Product meeting requirements of ASTM C 36, C 1396. Board installed in areas accessible to public shall have tapered edge to accommodate taping and face paper suitable for painting.

2.2 ACCESSORIES

A. Gypsum Board Mounting Accessories:
   1. Class Two Quality Standards:
      a. Furring Channels:
         1) Walls: Galvanized DWC-25 by USG.
         2) Ceilings: Galvanized DWC-20 by USG.
      b. Resilient Channels: RC-1 by USG.
      c. Other accessories as required by Manufacturer's fire tests to provide necessary fire ratings.

B. Corner And Edge Trim:
   1. Metal: 24 ga minimum steel, electrolytic galvanized zinc-coated, treated for maximum cement and paint adhesion. Surfaces to receive bedding cement knurled for maximum bonding.
   2. Paper-Faced Metal:
      a. Type Two Acceptable Products:
         1) Beadex Drywall Accessories.
         2) Chicago Metallic.
         3) Goldline Drywall Trim by Unimast.
         4) USG.
         5) Equal as approved by Architect before installation. See Section 01 6200.

C. Joint Compound:
   1. Best grade or type recommended by Board Manufacturer and meeting requirements of ASTM C 475.
      a. Use Taping Compound for first coat to embed tape and accessories.
      b. Use Taping Compound or All-Purpose Compound for subsequent coats except final coat.
      c. Use Finishing Compound for final coat and for skim coat.
      d. Joint Reinforcing: Paper reinforcing tape acceptable to Board Manufacturer.

D. Primer / Surfacer Under Surfaces To Receive Texturing:
   1. Type Two Acceptable Products:
      a. Sheetrock First Coat by USG.
      b. Prep Coat Plus by Hamilton Materials.
      c. ProForm Surfacer / Primer by National Gypsum.
      d. Level Coat by Magnum Products.

e. Equal as approved by Architect before bidding. See Section 01 6200.

E. Primer Under Surfaces To Receive Wallcovering:
1. White, self-sizing, water based, all purpose wallcovering primer.
2. Type Two Acceptable Products:
a. Shieldz Universal Pre-Wallcovering Primer by Wm. Zinsser and Company
b. Equal as approved by Architect before application. See Section 01 6200.

F. Fasteners:
1. Bugle head screws meeting requirements of ASTM C 1002.
a. Types:
1) Type W: For fastening gypsum board to wood members.
2) Type S: For fastening gypsum board to steel framing and ceiling suspension members.
b. Lengths:
1) Of length to penetrate wood framing 5/8 inch minimum.
2) Of length to penetrate steel framing 3/8 inch minimum.

2.3 MANUFACTURERS

A. Contact Information:
1. Beadex Drywall Accessories, Auburn, WA www.usg.com.
2. Chicago Metallic, Chicago, IL www.chicago-metallic.com.
3. Drywall Systems International, Bend, OR www.no-coat.com.
4. Georgia Pacific, Atlanta, GA (800) 225-6119 or (404) 652-4000. www.gp.com.
5. Hamilton Materials Inc, Orange, CA www.hamiltonmaterials.com.
6. Magnum Products, Lenaxa, KS www.levelcoat.com.
7. National Gypsum, Charlotte, NC www.national-gypsum.com.
8. United States Gypsum Co, Chicago, IL www.usg.com.
9. Wm. Zinsser & Co, Somerset, NJ www.zinsser.com.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work: Coordinate with Division 06 for location of backblocking for edges and ends of gypsum board and for blocking required for installation of equipment and building specialties. Do not install gypsum board until required blocking is in place.

B. General: Install and finish as recommended in ASTM C 840 unless specified otherwise in this Section.

C. Mounting Accessories:
1. Furring Channels: Apply with screws through flanges into each framing member.

D. Interior Gypsum Board:
1. General:
a. Install so trim and reinforcing tape are fully backed by gypsum board. No hollow spaces between pieces of gypsum board over 1/8 inch wide before taping are acceptable.
b. Rout out backside of gypsum board to accommodate items that extend beyond face of framing, but do not penetrate face of gypsum board, such as metal door frame mounting brackets, etc.
2. Single Layer Application:
a. Apply ceilings first using minimum of two men.
b. Use board of length to give minimum number of joints.
c. On walls over 108 inches high and on ceilings, apply board perpendicular to support.
d. Stagger end joints. End and edge joints of board applied on ceilings shall occur over framing members or be back blocked with 2x4 blocking. End joints of board horizontally

applied on walls shall occur over framing members. Edge joints of board vertically applied on walls shall occur over framing members.

e. Butt edges in moderate contact. Do not force in place. Shim to level.

f. Leave facings true with joint, finishing flush. Vertical work shall be plumb and ceiling surfaces level.

g. Scribe work closely. Keep joints as far from openings as possible. If joints occur near an opening, apply board so vertical joints are centered over openings. No vertical joints shall occur within 8 inches of external corners or openings.

h. Install board tight against support with joints even and true. Tighten loose screws.

i. Calk perimeter joints in sound insulated rooms with specified acoustical sealant.

3. Fastening:

a. Apply from center of board towards ends and edges.

b. Apply screws 3/8 inch minimum from ends and edges, one inch maximum from edges, and 1/2 inch maximum from ends.

c. Spacing:

1) Ends: Screws not over 7 inches on center at edges where blocking or framing occurs.

2) Metal Framed Walls: Screws 12 inches on center in panel field.

d. Set screw heads 1/32 inch below plane of board, but do not break face paper. If face is accidentally broken, apply additional screw 2 inches away.

e. Screws on adjacent ends or edges shall be opposite each other.

f. Drive screws with shank perpendicular to face of board.

4. Trim:

a. Corner Beads:

1) Attach corner beads to outside corners.

a) Attach metal corner bead with staples spaced 4 inches on center maximum and flat taped over edges of corner bead. Also, apply screw through edge of corner bead where wood trim will overlay corner bead.

b) Set paper-faced trim in solid bed of taping compound.

b. Edge Trim: Apply where gypsum board abuts dissimilar material in accordance with Manufacturer's instructions. Hold channel and 'L' trim back from exterior metal window and metal door frames 1/8 inch to allow for calking.

5. Finishing:

a. General:

1) Tape and finish joints and corners throughout building as specified below to correspond with final finish material to be applied to gypsum board. When sanding, do not raise nap of gypsum board face paper or paper-faced trim.

2) First Coat:

a) Apply tape over center of joint in complete, uniform bed of specified taping compound and wipe with a joint knife leaving a thin coating of joint compound. If metal corner bead is used, apply reinforcing tape over flange of metal corner bead and trim so half of tape width is on flange and half is on gypsum board.

b) Completely fill gouges, dents, and fastener dimples.

c) Allow to dry and sand lightly if necessary to eliminate high spots or excessive compound.

3) Second Coat:

a) Apply coat of specified joint compound over embedded tape extending 3-1/2 inches on both sides of joint center. Use finishing compound only if applied coat is intended as final coat.

b) Re-coat gouges, dents, and fastener dimples.

c) Allow to dry and sand lightly to eliminate high spots or excessive compound.

4) Third Coat: Apply same as second coat except extend application 6 inches on both sides of joint center. Allow to dry and sand with fine sandpaper or wipe with damp sponge.

5) Fourth Coat: Apply same as second coat except extend application 9 inches on both sides of joint center. Allow to dry and sand with fine sandpaper or wipe with damp sponge.

b. Finishing Levels:

1) Gypsum Board Surfaces not painted or finished:

a) GA-214-96 Level One: ‘Joints and interior angles shall have tape set in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.’

2) Gypsum Board Surfaces to Receive Painted Texturing, and Smooth Gypsum Board Surfaces in Mechanical, Storage, And Utility Areas:

a) GA-214-96 Level Four: 'Joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over flat joints and one separate coat of joint compound applied over interior angles. Cover fastener heads, and accessories with three separate coats of joint compound. Joint compound shall be smooth and free of tool marks and ridges. Coat prepared surface with specified primer / surfacer.'

3.2 CLEANING

A. Remove from site debris resulting from work of this Section including taping compound spills.

END OF SECTION

SECTION 09 3005

TILE SETTING MATERIALS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of tile setting materials and accessories furnished and installed under other Sections.

B. Related Sections:
   1. Section 22 1313: Floor drains.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A118.1-1999, ‘Specifications for Dry-Set Portland Cement Mortar.’

B. American Society For Testing And Materials:
   1. ASTM C 144-03, 'Standard Specification for Aggregate for Masonry Mortar.'
   2. ASTM C 150-04, 'Standard Specification for Portland Cement.'
   3. ASTM C 206-03, 'Standard Specification for Finishing Hydrated Lime.'
   4. ASTM C 207-01, 'Standard Specification for Hydrated Lime for Masonry Purposes.'
   5. ASTM C 1178-01, 'Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel.'

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in their original unopened containers with labels intact until time of use. Store and handle materials in a manner to prevent damage or contamination by water, freezing, or foreign matter.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Glass Mat Gypsum Tile Backer:
   1. Tile Backer:
      a. 5/8 inch thick water-resistant tile backer meeting requirements of ASTM C 1178, Type X.
      b. Category Four Approved Manufacturer. See Section 01 6200 for definitions of Categories.
         1) Dens-Shield Fireguard by G-P Gypsum.
   2. Fasteners:
      a. Metal Framing: 1-7/8 inch long Type S Hi-Lo screws.
   3. Joint Tape: 2 inch wide glass fiber mesh tape.

B. Dry-Set Portland Cement Mortar:
   1. Glazed White Body Wall Tile Setting Mortar:
      a. Meet requirements of ANSI A118.1 for manufactured mortar.
      b. Category Four Approved Products. See Section 01 6200 for definitions of Categories.

1) Tile Mate by Bostik.
2) Permabond by C-Cure.
3) Custom Thinset by Custom.
4) 253 Gold Multi-Purpose Thin Set by Laticrete.
5) Kerabond by Mapei.
6) Thin-Set 700 by Mer-Krete Systems.
7) S-777 by Summitville Labs.
8) Latex-Modified Thin Set Mortar 345 by TEC.

C. Metal Trim:
1. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a. Tile / Carpet Junction: Schluter-RENO-AETK.
b. Font Stair Nosing: Schluter-TREP-B, one inch, color G or HB as selected by Architect.
c. Over Expansion Joints In Slabs: Schluter DILEX-BWS, color G, PG, or HB as selected by Architect.
d. Floor / Wall Junction: Schluter-DILEX-EK, color G, PG, or HB as selected by Architect.
e. Wall / Wall Junction: Schluter-DILEX-EKE color G, PG, or HB as selected by Architect.

D. Joint Sealants:
1. Standard color to closely match grout joints as selected by Architect.
2. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a. Tub, Tile, And Ceramic Silicone Sealant by Dow Corning.
b. Sanitary 1700 by General Electric.
c. Latisil Sealant by Laticrete.
d. Pro-Select Kitchen And Bath Silicone Sealant by Sherwin Williams.

E. Commercial Portland Cement Non-Sanded Grout:
1. Color as selected by Architect.
2. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a. Bonsal Polymer Modified Unsanded Tile Grout by Bonsal American.
b. Dry Tile Grout with Hydroment Multi-Purpose Acrylic Latex Grout Additive by Bostik.
c. 1600 Series Unsanded Dry Set Wall Grout with 1776 Grout Admix Plus additive by Laticrete.
d. Keracolor-U Unsanded Polymer-Modified Grout by Mapei.
e. S-667 Unsanded Joint Filler with S-775 Acrylic Latex Additive by Summitville Labs.
f. TA-610 Unsanded Wall Grout by TEC.

F. Penetrating Sealer:
1. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a. 511 Impregnator by Miracle Sealants.
b. Sealer's Choice by Aqua Mix.

2.2 MANUFACTURERS

A. Contact Information:
1. Aqua Mix Inc, Santa Fe Springs, CA www.aquamix.com.
2. Bonsal American, Charlotte, NC (800) www.bonsal.com.
3. Bostik Construction Products, Middleton, MA www.bostik-us.com.
4. C-Cure Chemical Co Inc, Houston, TX www.c-cure.com.
5. ColorFast Industries Inc, Colton, CA www.colorfastind.com.
6. Custom Building Products, Seal Beach, CA www.custombuildingproducts.com.
7. DalTile - Dallas Ceramics, Dallas, TX www.daltile.com.
8. Dow Corning Corp, Midland, MI www.dowcorning.com.
9. G E Silicone Products, Waterford, NY www.gesilicones.com.
10. Georgia Pacific Gypsum Corp, Atlanta, GA www.gp.com.
11. Laticrete International Inc, Bethany, CT www.laticrete.com.
12. Mapei, Deerfield Beach, FL www.mapei.com.
13. Mer-Krete Systems, Torrance, CA www.merkote.com.
14. Miracle Sealants Co, Arcadia, CA www.miraclesealants.com.

15. NAC - National Applied Construction Products, Akron, OH www.nac-anti-fracture.com.
16. The Noble Company, Grand Haven, MI www.noblecompany.com.
17. Schluter Systems LP, Plattsburgh, NY www.schluter.com.
18. Sherwin-Williams, Cleveland, OH www.sherwin-williams.com.
19. Summitville Labs, Summitville, OH www.summitville.com.
20. TEC Inc, Palatine, IL www.tecspecialty.com.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 09 3013

CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install ceramic tile and tile setting materials and accessories as described in Contract Documents.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A137.1-1988, 'Ceramic Tile.'

B. Tile Council of North America:
   1. TCNA Handbook, 'Handbook for Ceramic Tile Installation, 2006.'

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's cut sheets of materials used in installed system.
   2. Cleaning and maintenance instructions.
   3. Color and pattern selections.

B. Samples:
   1. 24 inch square sample on specified tile backer showing all types of tile, grout, and colors specified in this Section. 1/2 of sample board shall show font tile and 1/2 of board shall show wall tile.
   2. One sample of each type of base tile and trim piece to be used on Project.

C. Quality Assurance / Control: Master grade certificate.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in their original unopened containers with labels intact until time of use. Store and handle materials in a manner to prevent damage or contamination by water, freezing, or foreign matter.

B. Keep grade seals intact and cartons dry until tile are used.

1.5 PROJECT CONDITIONS

A. Project Environmental Requirements: Keep ambient temperatures of area to receive tile work and surface temperatures of substrates at 50 deg F minimum during preparation of mortar bed, laying of tile, and for 72 hours after completion of tile work. Use electric heat to prevent discoloration of grout.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Tile:
   1. Tile shall be standard quality, white or off-white body, square or cushion edge, graded in accordance with ANSI A137.1.
      a. Field tile shall have two lugs on each edge to assure uniform joint, approximately 0.040 inch.
      b. External and internal corner pieces shall be standard grade.
   2. Wall:
      a. Walls:
         1) Square edge, white body, lug type.
         2) 4-1/4 inches by 4-1/4 inches.
      b. Ceramic Tile Base: 4-1/4 inch. When base only is installed at painted walls, use one course of base and one course of bull-nose wall tile.
      c. Color Performance Standards:
         1) Room Walls: **Semi-gloss – price group 2 by Dal Tile**
      d. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
         1) Bright Glaze or Matte Glaze Series by American Olean.
         2) Semi-Gloss or Matte by Dal-Tile.
         3) IC Brites Series by Interceramics.

2.2 MANUFACTURERS

A. Contact Information:
   1. American Olean Tile Co, Div Dal-Tile International, Lansdale, PA www.aotile.com
   2. Dal-Tile - Dallas Ceramics, Dallas, TX www.daltile.com
   3. Interceramic USA, Garland, TX www.interceramicusa.com

PART 3 - EXECUTION

3.1 APPROVED INSTALLERS

A. Tile installers shall have 5 years minimum experience, and be acceptable to the Contractor, Architect, and Owner.

3.2 EXAMINATION

A. Site Verification of Conditions:
   1. Plane of Vertical Surfaces: 1/8 inch in 8 feet from required plane. Shall be plumb and true with square corners.

3.3 PREPARATION

A. Allow concrete to cure for 28 days minimum before application of setting bed.

B. Grounds, anchors, plugs, hangers, door frames, electrical, mechanical, and other work in or behind tile shall be installed before tile work is started.

3.4 INSTALLATION

A. General:
1. Install in accordance with TCNA standards.

    a. Walls:
        1) Framed: TCNA W245.
    b. Base: Thin-lip or flush style.
2. Install tile in pattern indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Adjust to minimize tile cutting and to avoid tile less than half size. Center and balance areas of tile if possible.
3. Extend tile into recesses and under equipment and fixtures to form a complete covering without interruption.
4. Maintain heights of tilework in full courses to nearest obtainable dimension where heights are given in feet and inches and are not required to fill vertical spaces exactly.
5. Install cut tile with cuts on outer edges of field. Provide straight cuts that align with adjacent materials. When possible, smooth cut edges of tile or use appropriate cutter or wet saw to produce smooth cuts. Do not install tile with jagged or flaked edges.
6. Terminate tile neatly at obstructions, edges, and corners, without disruption of pattern or joint alignment. Fit tile closely where edges are to be covered by trim, escutcheons, or similar devices.
7. Provide straight tile joints of uniform width, subject to variance in tolerance allowed in tile size. Make joints smooth and even, without voids, cracks, or excess mortar or grout.
8. Accessories in tilework shall be evenly spaced, properly centered with tile joints, and level, plumb, and true to correct projection.
9. Install tile before mortar has started initial cure. For thin set mortar application, use a notch trowel that will achieve the recommended coverage of mortar after tiles have been installed.
10. Do not spread more mortar than can be covered within 10 to 15 minutes. If 'skinning' occurs, remove mortar and spread fresh material. Spread mortar with notches running in one direction, perpendicular to pressing, pushing and pulling of tile during placement.
11. Place tile in fresh mortar, press, push and pull tile slightly to achieve as near 100 percent coverage and contact of tile with setting material and substrate as possible. Coverage shall be 85 percent minimum and be sufficiently distributed to give full support of the tile. Support corners and edges with mortar leaving no hollow corners or edges.
12. Install so there is 1/8 inch of mortar between tile and substrate after proper bedding. Periodically remove sheets or individual tiles to assure proper bond coverage consistent with industry specifications. If coverage is found to be insufficient, use a larger size notch trowel.
13. Use a beating block and hammer or rubber mallet so faces and edges of individual tiles are flush and level with faces and edges of adjacent tiles, and to reduce lippage.
14. Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

B.
1. On Glass Mat Gypsum Tile Backer Over Framing:
    a. Apply glass mat gypsum tile backer to framing. Attach using specified fasteners spaced 6 inches 150 mm on center on edges and into all framing members. Drive screws flush with surface of board.
    b. Shim board to be plumb and flat or level and flat, depending on location.
    c. At joints, embed fiberglass reinforcing tape with mastic or mortar used to adhere tile.
2. Dampen dry backings as determined by environmental conditions and Manufacturer's recommendations to achieve cure.
3. Allow for sealant joints full height at room corners in wall tile. Insert temporary filler in expansion joints.

C. Penetrating Sealers:
1. Thoroughly clean tile.
2. Apply on day following installation of Portland cement grout.

3. Wipe two thin coats with white cotton towel or cloth with each coat applied 90 degrees to each other. Allow 30 minutes between coats. Do not allow contact with epoxy grout.

D. Application of Joint Sealants And Grout:
1. Grout Types: Use Portland cement grout with wall tile and with tile in Font.
2. Firmly set tile before applying grout. This requires 48 hours minimum.
3. Remove spacers or ropes before grouting.
4. Firmly set tile before applying joint sealants or grout. This requires 48 hours minimum.
5. Remove spacers or ropes before applying joint sealants or grouting. Apply sealants before applying grout.
6. Apply backer rod and joint sealants at expansion joints. Apply bead of sealant at junction of base and floor tile.
7. Before grouting entire area, do a test area to assure there will be no permanent staining or discoloration of tile and to verify that excess grout can be easily removed from tile surface. If necessary, pre-coat exposed surfaces of tile with a grout release recommended by Grout Manufacturer to facilitate removal of excess grout.
8. Use clean buckets and mixing tools. Use sufficient pressure and flow grout in progressively to avoid air pockets and voids.
9. Apply grout to produce full, smooth grout joints of uniform width, and free of voids and gaps. Fill joints of cushion edge tile to depth of cushion. Fill joints of square edge tile flush with surface.
10. Remove excess grout from surface of tile before it loses its plasticity or begins to set.
11. Finished grout shall be uniform in color, smooth, and without voids, pin holes, or low spots.

3.5 CLEANING

A. If one has been used, remove grout release and clean tile surfaces so they are free of grout residue and foreign matter. If a grout haze or residue remains, use a suitable grout haze remover or cleaner. Flush surface with clean water before and after cleaning.

3.6 PROTECTION

A. Close to traffic areas where tile is being set and other tile work being done. Keep closed until tile is firmly set. Before, during, and after grouting, keep area clean, dry, and free from foreign materials and airflow that will interfere with setting and curing of grout.

B. After cleaning, provide protective covering and maintain conditions protecting tile work from damage and deterioration. Where tiled surfaces will be subject to equipment or wheel traffic or heavy construction traffic, cover protective covering with 1/4 inch hardboard, plywood, or similar material.

END OF SECTION

SECTION 09 5113

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install acoustical ceiling panels for suspended acoustical ceilings as described in Contract Documents.

1.2 SUBMITTALS

A. Product Data:
   1. Manufacturer's literature.
   2. Color and pattern selection.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store materials where protected from moisture and damage.

B. Use no soiled, scratched, or broken material in the Work.

1.4 PROJECT CONDITIONS

A. Project Environmental Requirements: Building shall be enclosed, mechanical system operating with proper filters in place, and temperature and humidity conditions stabilized within limits under which Project will operate before, during, and after installation until Substantial Completion.

1.5 MAINTENANCE

A. Extra Materials:
   1. Provide Owner with one carton of each type of tile for future use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Acoustic Panels:
   1. Finish: Abuse-resistant / durable. Use tile from same color run in individual rooms to assure color match.
   2. Rating: Match UL fire-resistance classification of suspension system.
   3. Thickness: 3/4 inch minimum.
   4. Performance Standard: Natural Fissured by Celotex.
   5. Category Four Acceptable Manufacturers. See Section 01 6000.
      a. Armstrong.
      b. BPB Celotex.
      c. Eurostone by Chicago Metallic.
      d. USG.

2.2 MANUFACTURERS

A. Contact Information:
   1. Armstrong World Industries Co, Lancaster, PA www.ceilings.com.
   2. BPB Celotex, Tampa, FL www.bpb-na.com.
   3. Eurostone by Chicago Metallic Corp, Chicago, IL www.chicago-metallic.com.
   4. USG Interiors Inc, Chicago, IL www.usg.com.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect for defects in support that are not acceptable. Report defects to Architect in writing. Do not install ceiling panels until defects in support are corrected.

3.2 INSTALLATION

A. Materials shall be dry and clean at time of application.

B. If recommended by Manufacturer, use tile one at a time from at least four open boxes to avoid creating any pattern due to slight variations from box to box.

C. Leave tile in true plane with straight, even joints.

3.3 ADJUSTING

A. 'Touch-up' minor abraded surfaces.

B. Remove and replace discolored panels to match adjacent panels.

C. Remove and replace damaged panels at no additional cost to Owner.

3.4 CLEANING

A. Remove from site all debris connected with work of this Section.

END OF SECTION

SECTION 09 5323

METAL ACOUSTICAL SUSPENSION ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install acoustical suspension system as described in Contract Documents.

B. Related Requirements:
   1. Section 09 5113: Acoustical ceiling panels.
   2. Section 26 5100: Interior light fixtures.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM C 635-00, 'Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.'
      b. ASTM C 636-06, 'Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.'

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Meet seismic bracing requirements of Section 1621.2.5.2 of 2006 IBC, or equivalent governing standard for Project site.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Type One Acceptable Manufacturers:
      a. Armstrong World Industries, Lancaster, PA www.armstrong.com.
      b. Chicago Metallic Corporation, Chicago, IL www.chicagometallic.com.
      c. USG Inc, Chicago, IL www.usg.com.
      d. Equal as approved by Architect before bidding. See Section 01 6200.

B. Materials:
   1. Grid:
      a. Systems shall meet requirements of ASTM C 635, Heavy Duty suspension system.
      b. Exposed surfaces shall be finished with factory-applied white baked enamel.
      c. Main runners and cross T's shall have 9/16 inch exposed face in a narrow revealed edge.
      d. Main runners and cross T's shall have one inch exposed face.
   2. Performance Standards: DXL Systems by USG Interiors.
   3. Hanger Wire: 12 gauge cold-rolled electro-galvanized steel.
   4. Edge Molding: Channel section of cold-rolled electro-galvanized steel. Use 2 in exposed face inch edge molding.
   5. Hold-down Clips: As required by UL to prevent lifting of panels under unusual draft conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Work shall be in accordance with Manufacturer's recommendations insofar as they are concerned with Contract Documents. Installation shall meet requirements of ASTM C 636.

B. Lay out suspension system symmetrically about center lines of room unless shown otherwise by Drawings. Lay out system so use of tiles less than 1/2 size is minimized.

C. Maintain suspension system in true plane with straight, even joints.

D. Suspension system joints shall be straight and in alignment, and exposed surface flush and level. Wherever system abuts walls, columns, and other vertical surfaces, furnish and install appropriate molding.

E. Locate light fixtures, speakers, and mechanical diffusers and grilles symmetrically in room insofar as possible (unless shown otherwise). Locate fixtures, speakers, diffusers, and grilles within suspension grid spaces and centered at least one direction within grid.

F. Pay particular attention to required hanger wire placement and fixture protection. Individual component deflection not to exceed 1/360 of span.

G. Suspension system shall comply with requirements of Utah State Building Official.

END OF SECTION

SECTION 09 9001

COMMON PAINTING AND COATING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common procedures and requirements for field-applied painting and coating.

B. Related Requirements:
   1. Section 05 0503: Quality of shop priming of steel and iron.
   2. Section 07 9213: Quality of Elastomeric Joint Sealants.
   3. Section 09 2900: Priming of gypsum board before texturing.
   4. Section 09 6466, 09 6467, or 09 0162: Finishing of hardwood flooring.
   5. Section 09 9413: Textured finishing.
   6. Divisions 22 and 23: Painting of plumbing and HVAC identification, refrigerant line insulation, and duct interiors.
   7. Section 32 1723: Pavement Marking.

1.2 REFERENCES

A. Reference Standards:
   1. Master Painters Institute:
      a. MPI(a), Mar 2001, 'Architectural Painting Specification Manual.'

B. Definitions:
   1. Gloss Levels:
      a. Specified paint gloss level shall be defined as sheen rating of applied paint, in accordance with following terms and values, unless specified otherwise for a specific paint system.

Gloss Level ‘1’	Traditional matte finish - flat	0 to 5 units at 60 degrees to 10 units maximum at 85 degrees.
Gloss Level ‘2’	High side sheen flat - 'velvet-like' finish	10 units maximum at 60 degrees and 10 to 35 units at 85 degrees.
Gloss Level ‘3’	Traditional 'eggshell-like finish	10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
Gloss Level ‘4’	'Satin-like' finish	20 to 35 units at 60 degrees and 35 units minimum at 85 degrees.
Gloss Level ‘5’	Traditional semi-gloss	35 to 70 units at 60 degrees.
Gloss Level ‘6’	Traditional gloss	70 to 85 units at 60 degrees.
Gloss Level “7’	High gloss	More than 85 units at 60 degrees.

   2. Properly Painted Surface: Surface that is uniform in appearance, color, and sheen and free of foreign material, lumps, skins, runs, sags, holidays, misses, strike-through, and insufficient coverage. Surface free of drips, spatters, spills, and overspray caused by Paint Applicator. Compliance will be determined when viewed without magnification at a distance of 5 feet minimum under normal lighting conditions and from normal viewing position (MPI(a), PDCA P1.92).
   3. Damage Caused By Others: Damage caused by individuals other than those under direct control of Painting Applicator (MPI(a), PDCA P1.92).
   4. Latent Damage: Damage or conditions beyond control of Painting Applicator caused by conditions not apparent at time of initial painting or coating work.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
   1. Participate in pre-installation conference specified in Section 09 2900 to review finish requirements of gypsum wallboard.
   2. Schedule painting pre-installation conference after delivery of paint but before or at same time as application of field samples.

1.4 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Include following information for each painting system, arranged in same order as in Project Manual.
         1) Manufacturer's cut sheet for each component of each system indicating ingredients and percentages by weight and by volume, environmental restrictions for application, and film thicknesses and spread rates.
         2) Copies of appropriate entries from MPI Approved Product List. Products from MPI Approved Product List is mandatory for Sections 09 9112, 09 9123 and 09 9124. If proposed manufacturer has products listed for these three Sections, but not for other Sections, Architect may approve products submitted by proposed manufacturer for other Sections.
         3) Confirmation of colors selected and that each area to be painted or coated has color selected for it.
   2. Samples: Provide two 4 inch by 6 inch minimum draw-down cards for each paint or coating color selected for this Project.

B. Informational Submittals:
   1. Manufacturer Instructions: Manufacturer's substrate preparation instructions and application instruction for each painting system used on Project.

C. Closeout Submittals:
   1. Operations And Maintenance Data: Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Manufacturer's cut sheet for each component of each system.
      b. Schedule showing rooms and surfaces where each system was used.

D. Maintenance Materials Submittals:
   1. Extra Stock Materials:
      a. Provide painting materials in Manufacturer's original containers and with original labels in each color used. Label each can with color name, mixture instructions, date, and anticipated shelf life.
      b. Provide one quart of each finish coat and one pint of each primer and of each undercoat in each color used.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Paint and painting materials shall be free of lead and mercury, and have VOC levels acceptable to local jurisdiction.

B. Field Samples:
   1. No requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver specified products in sealed, original containers with Manufacturer's original labels intact on each container. Deliver amount of materials necessary to meet Project requirements in single shipment. Notify Architect two working days before delivery of coatings.

B. Store materials in single place.

C. Keep storage area clean and rectify any damage to area at completion of work of this Section. Maintain storage area at 55 deg F minimum.

1.7 FIELD CONDITIONS

A. Ambient Conditions:
   1. Perform painting operations at temperature and humidity conditions recommended by Manufacturer for each operation and for each product.
   2. Apply painting systems at lighting level of 540 Lux (50 foot candles) minimum on surfaces to be painted. Inspection of painting work shall take place under same lighting conditions as application. If painting and coating work is applied under temporary lighting, deficiencies discovered upon installation of permanent lighting will be considered latent damage as defined in MPI Manual, PDCA P1-92

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Performance:
   1. Design Criteria:
      a. Color Levels:
         1) Color Level II:
            a) Number and placement of interior and exterior paint colors and gloss levels shall be as defined by Color Level II from MPI Manual, PDCA P3-93 as modified in following paragraph.
            b) No more than one paint color or gloss level will be selected for same substrate within designated interior rooms or exterior areas.
         2) Color Level III:
            a) Number and placement of interior and exterior paint colors and gloss levels shall be Color Level III from MPI Manual, PDCA P3-93 as modified in following paragraph.
            b) Several paint colors or gloss levels will be selected for same substrate within designated interior rooms or exterior areas.

B. Materials:
   1. Materials used for any painting system shall be from single manufacturer unless approved otherwise in writing by painting system manufacturers and by Architect. Include manufacturer approvals in Product Data submittal.
   2. Linseed oil, shellac, turpentine, and other painting materials shall be pure, be compatible with other coating materials, bear identifying labels on containers, and be of highest quality of an approved manufacturer listed in MPI manuals. Tinting color shall be best grade of type recommended by Manufacturer of paint or stain used on Project.

PART 3 - EXECUTION

3.1 APPROVED APPLICATORS

A. Applicator shall have experience in application of specified products for five years minimum and be acceptable to Architect and Paint Manufacturer.

3.2 EXAMINATION

A. Directing applicator to begin painting and coating work will indicate that substrates to receive painting and coating materials have been previously inspected as part of work of other Sections and are complete and ready for application of painting and coating systems as specified in those Sections.

B. Before beginning work of this Section, examine, and test surfaces to be painted or coated for adhesion of painting and coating systems. Report in writing to Architect of conditions that will adversely affect adhesion of painting and coating work. Do not apply painting and coating systems until party responsible for adverse condition has corrected adverse condition.

C. Report defects in substrates that become apparent after application of primer or first finish coat to Architect in writing and do not proceed with further work on defective substrate until such defects are corrected by party responsible for defect.

3.3 PREPARATION

A. Protection Of In-Place Conditions:
   1. Protect other finish work and adjacent materials during painting. Do not splatter, drip, or paint surfaces not intended to be painted. These items will not be spelled out in detail but pay special attention to the following:
      a. Do not paint finish copper, bronze, chromium plate, nickel, stainless steel, anodized aluminum, or monel metal except as explicitly specified.
      b. Keep cones of ceiling speakers completely free of paint. In all cases where painting of metal speaker grilles is required, paint without grilles mounted to speakers and without grilles on ceiling.

B. Surface Preparation:
   1. Prepare surfaces in accordance with MPI requirements and requirements of Manufacturer for each painting system specified, unless instructed differently in Contract Documents. Bring conflicts to attention of Architect in writing.
   2. Fill minor holes and cracks in wood surfaces to receive paint or stain.
   3. Surfaces to be painted shall be clean and free of loose dirt. Clean and dust surfaces before painting or finishing.
   4. Do no exterior painting while surface is damp, unless recommended by Manufacturer, nor during rainy or frosty weather. Interior surfaces shall be dry before painting. Moisture content of materials to be painted shall be within tolerances acceptable to Paint Manufacturer.
   5. Sand woodwork smooth in direction of grain leaving no sanding marks. Clean surfaces before proceeding with stain or first coat application.

3.4 APPLICATION

A. Interface With Other Work:
   1. Coordinate with other trades for materials and systems that require painting before installation.
   2. Schedule painting and coating work to begin when work upon which painting and coating work is dependent has been completed. Schedule installation of pre-finished and non-painted items, which are to be installed on painted surfaces, after application of final finishes.

B. Paint or finish complete all surfaces to be painted or coated as described in Contract Documents, including but not limited to following items:
   1. Finish casework and wood trims that are specified to be installed under Section 06 2001 and that are not called out to be factory- or shop-finished. Back prime wood elements to be installed against concrete or masonry or that may be subjected to moisture.
   2. Paint mechanical, electrical, and audio/visual items that require field painting as indicated in Contract Documents. These include but are not limited to:
      a. Gas pipe from gas meter into building.
      b. Mechanical flues and pipes penetrating roof.
      c. Electrical panel and disconnect enclosures.
      d. Metal protective structures for refrigerant lines.
   3. Metal reveals at ceiling access doors.
   4. Paint inside of chases in occupied spaces flat black for 18 inches or beyond sightline, whichever is greater.

C. Apply sealant in gaps 3/16 inch and smaller between two substrates that are both to be painted or coated. Sealants in other gaps furnished and installed under Section 07 9213.

D. On wood to receive a transparent finish, putty nail holes in wood after application of stain using natural colored type to match wood stain color. Bring putty flush with adjoining surfaces.

E. In multiple coat paint work, tint each succeeding coat with slightly lighter color, but approximating shade of final coat, so it is possible to check application of specified number of coats. Tint final coat to required color.

F. Spread materials smoothly and evenly. Apply coats to not less than wet and dry film thicknesses and at spreading rates for specified products as recommended by Manufacturer.

G. Touch up suction spots after application of first finish coat.

H. Paint shall be thoroughly dry and surfaces clean before applying succeeding coats.

I. Use fine sandpaper between coats as necessary to produce even, smooth surfaces.

J. Make edges of paint adjoining other materials or colors clean, sharp, and without overlapping.

K. Finished work shall be a 'Properly Painted Surface' as defined in this Section.

3.5 ADJUSTMENT

A. Correct deficiencies in workmanship as required to leave surfaces in conformance with 'Properly Painted Surface,' as defined in this Section. Correction of 'Latent Damage' and 'Damage Caused By Others,' as defined in this Section, is not included in work of this Section.

3.6 CLEANING

A. Remove rags and waste used in painting operations from building each night. Take every precaution to avoid danger of fire.

B. As work proceeds and upon completion of work of any painting Section, remove paint spots from floors, walls, glass, or other surfaces and leave work clean, orderly, and in acceptable condition. Remove debris caused by work of paint Sections from premises.

END OF SECTION

ATTACHMENTS

PART 4 - PAINT COLOR SCHEDULE

A. Colors:
   1. Interior:
      a. Interior Poured Concrete:
         1) Class One Color Quality Standard. See Section 01 6200.
            a) **<Insert Product and Color>** by **<Insert Manufacturer>**.
      b. Interior CMU:
         1) Class One Color Quality Standard. See Section 01 6200.
            a) **<Insert Product and Color>** by **<Insert Manufacturer>**.
      c. Interior Gypsum Board, Plaster:
         1) Class One Color Quality Standard. See Section 01 6200.
            a) **<Insert Product and Color>** by **<Insert Manufacturer>**.
      d. Interior Metal:
         1) Class One Color Quality Standard. See Section 01 6200.
            a) **<Insert Product and Color>** by **<Insert Manufacturer>**.
   2. Exterior:
      a. Exterior Metal:
         1) Class One Color Quality Standard. See Section 01 6200.
            a) **<Insert Product and Color>** by **<Insert Manufacturer>**.

SECTION 09 9113

INTERIOR & EXTERIOR PAINTED GALVANIZED METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Preparing and painting new interior and exterior exposed galvanized metal surfaces as Described in Contract Documents.
   2. Preparing and painting following existing exterior exposed galvanized metal surfaces as described in Contract Documents.
      a. Metal doors & frames.
      b. Metal stairs, ladders & cat-walks
      c. Overhead coiling doors
      d. Handrails & guardrails
      e. Misc metal fabrications
      f. Structural steel roof & mezzanine beams & girders & connections
      g. Metal roof & floor deck
      h. Misc. structural connections, bolts, etc.

B. Related Sections:
   1. Section 09 9001: Common Painting Requirements.

1.2 SYSTEM DESCRIPTION

A. Handrails And Exposed Miscellaneous Structural Steel: Use MPI(a) EXT 5.3D Pigmented Polyurethane Finish system for new work.

B. All Other: Use MPI(a) EXT 5.3H Latex Finish system for new work.

C. Use MPI Premium Grade finish requirements for new work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Gloss / Sheen Level Required: Gloss Level 5.

B. Category Four Approved Products. See Section 01 6000 for definitions of Categories.
   1. Products listed in edition of MPI Approved Product List current at time of bidding and later are approved, providing they meet VOC requirements in force where Project is located.
   2. Polyurethane:
      a. Vinyl Wash Primer Coat: MPI Product 80.
      b. Finish Coats:
         1) Epoxy MPI Product 101.
         2) Polyurethane MPI Product 72.
   3. Latex:
      a. Waterborne Primer Coat: MPI Product 134.
      b. Finish Coats: MPI Product 11.

PART 3 - EXECUTION

3.1 APPLICATION

A. General: See appropriate paragraphs of Section 09 9001.

B. New Surfaces:
   1. Clean 'passivated' or 'stabilized' galvanized steel as specified in SSPC-SP1.
   2. After removal of 'passivated' or 'stabilized' coating or for surfaces without coating, clean surfaces to be painted with mineral spirits or product recommended by Paint Manufacturer. Change to clean rags or wiping cloths regularly to reduce possibility of re-contamination of surface.
   3. Apply prime coat.
   4. Apply finish coats.

END OF SECTION

SECTION 09 9121

INTERIOR PAINTED POURED CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Preparing and painting of new concrete floors to be left exposed in finished building, as described in Contract Documents.

B. Related Sections:
   1. Section 09 9001: Common Painting Requirements.

1.2 SYSTEM DESCRIPTION

A. Use MPI(a) INT 3.2A Latex Finish system

B. Finish Requirements: Use MPI Custom Grade finish requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Gloss / Sheen Level Required: Semi-Gloss.

B. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
   1. Products listed in edition of MPI Approved Product List current at time of bidding and later are approved, providing they meet VOC requirements in force where Project is located.
   2. MPI Product 60.

PART 3 - EXECUTION

3.1 APPLICATION

A. General: See appropriate paragraphs of Section 09 9001.

END OF SECTION

SECTION 09 9122

INTERIOR PAINTED CMU

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Preparing and painting new interior CMU walls as described in Contract Documents.
   2. Preparing and painting existing interior CMU surfaces listed below as described in Contract Documents:
      a. Exterior Walls

B. Related Sections:
   1. Section 09 9001: Common Painting Requirements.

1.2 SYSTEM DESCRIPTION

A. Use MPI(a) INT 4.2D Latex Finish system for new work and MPI(r) REX 4.2H Latex Finish system for previously painted work.

B. Use MPI Custom Grade finish requirements for new work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Gloss / Sheen Level Required: Gloss Level 5.

B. Category Four Approved Products. See Section 01 6000 for definitions of Categories.
   1. Products listed in edition of MPI Approved Product List current at time of bidding and later are approved, providing they meet VOC requirements in force where Project is located.
   2. Block Filler, Over New Masonry Only: MPI Product 4.
   3. Finish Coats: MPI Product 141.

PART 3 - EXECUTION

3.1 APPLICATION

A. General: See appropriate paragraphs of Section 09 9001.

B. Existing Painted Surfaces:
   1. Remove deteriorated existing paint by scraping or sanding. Wash surfaces that have been defaced with marking pens, crayons, lipstick, etc, with solvent recommended by Paint Manufacturer. Spot prime such surfaces.
   2. Sand areas of existing sound paint if necessary for bonding of new paint system. Clean existing painted surfaces, sanded or not, with mild soap and water, or with tri-sodium phosphate (TSP).
   3. Fill large holes with patching and small holes and cracks with spackle.
   4. Apply one coat primer to scraped and sanded areas.
   5. Apply one finish coat. Completely cover voids in masonry block but do not fill.

END OF SECTION

SECTION 09 9123

INTERIOR PAINTED GYPSUM BOARD, PLASTER

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Preparing, priming, and finish painting new interior gypsum board and plaster surfaces as described in Contract Documents.
   2. Priming new interior gypsum board surfaces to receive sheet wall covering system.
   3. Preparing and painting following existing interior gypsum board and plaster surfaces as described in Contract Documents:
      a. Gypsum Board Walls.

B. Related Sections:
   1. Section 09 9001: Common Painting Requirements.
   2. Section 09 9413: Textured finishings.

1.2 SYSTEM DESCRIPTION

A. Use MPI(a) INT 9.2B Latex Finish system for new work and MPI(r) RIN 9.2B Latex Finish system for previously painted work.

B. Use MPI Premium Grade finish requirements for new work.

C. Rest Rooms: Use MPI(a) INT 9.2F Waterborne Epoxy Finish system for new work.

D. All Other: Use MPI(a) INT 9.2B Latex Finish system for new work.

E. Use MPI Premium Grade finish requirements for new work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Category Four Approved Products: Products listed in edition of MPI Approved Product List current at time of bidding and later are approved, providing they meet VOC requirements in force where Project is located. See Section 01 6000 for definitions of Categories.

B. Primers
   1. All Other, except gypsum wallboard surfaces to receive Finish Levels 4 and 5: MPI Product 50.

C. Finish Coats:
   1. Gloss / Sheen Required: Gloss Level 5.
   2. MPI Product 141.
   3. Rest Rooms:
      a. Gloss / Sheen Required: Gloss Level 6.
      b. MPI Product 77.
      c. MPI Product 115.
   4. Remaining Painted Surfaces:
      a. Gloss / Sheen Required: Gloss Level 5.

b. MPI Product 141.

PART 3 - EXECUTION

3.1 APPLICATION

A. General: See appropriate paragraphs of Section 09 9001.

B. Interface With Other Work: Coordinate with sheet wall covering installers regarding suitability of primer.

C. New Surfaces:
1. Primer:
   a. On surfaces designated on Drawings to receive sheet wall covering or multi-color coating system, apply one coat of specified primer.
   b. Apply primer to be covered with other paint coats or with multi-color coating system with roller only, or with spray gun and back-rolled.

END OF SECTION

SECTION 09 9124

INTERIOR PAINTED METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Preparing and painting new interior metal surfaces as described in Contract Documents.
   2. Preparing and painting following existing interior metal surfaces as described in Contract Documents:
      a. Metal doors & frames.
      b. Structural Steel.
      c. Roof & Mezzanine floor deck.
      d. Metal Ladder.

B. Related Sections:
   1. Section 09 9001: Common Painting Requirements.

1.2 SYSTEM DESCRIPTION

A. Ferrous Metal : Use MPI(a) INT 5.1B Waterborne Light Industrial Finish system for new work and MPI(r) RIN 5.1B Waterborne Light Industrial Finish system for previously painted work.

B. Galvanized Metal: Use MPI(a) INT 5.3J Latex Finish system for new work and MPI(r) RIN 5.3AH Latex Finish system for previously painted work.

C. Use MPI Premium Grade finish requirements for new doors & frames. Use MPI Custom Grade requirements for all other work.

1.3 SEQUENCING

A. Paint brackets furnished under Section 05 5871 before installation of bracket.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Gloss / Sheen Level Required: Gloss Level 5.

B. Category Four Approved Products. See Section 01 6000 for definitions of Categories.
   1. Products listed in edition of MPI Approved Product List current at time of bidding and later are approved, providing they meet VOC requirements in force where Project is located.
   2. Primers:
      a. Ferrous Metal: MPI Product 107.
      b. Galvanized Metal: MPI Product 134.
   3. Finish Coats: MPI Product 110, G5.

PART 3 - EXECUTION

3.1 APPLICATION

A. General:
   1. See appropriate paragraphs of Section 09 9001.
   2. Systems specified are in addition to prime coats furnished under other Sections.

B. New Surfaces: Remove rust spots by sanding and immediately spot prime. If all traces of rust cannot be removed, apply rust blocker recommended by Paint Manufacturer before applying full primer coat.

END OF SECTION

SECTION 09 9321

INTERIOR SEALED CONCRETE FLOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Seal concrete floors that are to be left exposed in finished building as described in Contract Documents.

B. Related Sections:
   1. Section 09 9001: Common Painting And Coating Requirements.

1.2 SYSTEM DESCRIPTION

A. Use MPI(a) INT 3.2F or 3.2G Finish systems.

B. Use MPI Custom Grade requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Category Four Approved Products. See Section 01 6000 for definitions of Categories.
   1. Products listed in edition of MPI Approved Product List current at time of bidding and later are approved, providing they meet VOC requirements in force where Project is located.
   2. MPI Products 99 or 104.

PART 3 - EXECUTION

3.1 APPLICATION

A. See appropriate paragraphs of Section 09 9001.

B. Apply 3-coats of sealer.

END OF SECTION

SECTION 09 9413

INTERIOR TEXTURED FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and apply texturing on walls and ceilings as described in Contract Documents.

B. Related Sections:
   1. Section 09 2900: Priming.
   2. Section 09 9123: Finish painting.

1.2 SUBMITTALS

A. Samples: Provide minimum of three 24 inch square control samples on primed gypsum wallboard of light orange peel texture described by Architect, to show possible variations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Texturing:
   1. Light orange peel.
   2. Class Two Quality Standards: See Section 01 6000.
      a. ProForm Perfect Spray EM/HF by National Gypsum, Charlotte, NC www.national-gypsum.com.
      b. Sheetrock Wall & Ceiling Texture by U S Gypsum Co, Chicago, IL www.usg.com.

PART 3 - EXECUTION

3.1 APPLICATION

A. After gypsum board is taped, sanded, and primed, apply texture. Closely match samples accepted by Architect.

END OF SECTION

DIVISION 10: SPECIALTIES

10 1000 INFORMATION SPECIALTIES

10 1495 MISCELLANEOUS INTERIOR SIGNAGE

10 2000 INTERIOR SPECIALTIES

10 2813 COMMERCIAL TOILET ACCESSORIES

END OF TABLE OF CONTENTS

SECTION 10 1495

MISCELLANEOUS INTERIOR SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Products Installed And Furnished Under This Section:
   1. Interior signs.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Interior Signs:
   1. Provide tactile / braille features in signage.
   2. Room Signs: Molded clear acrylic sub-surface graphics sign with set-screw to attach to included mounting bracket.
   3. Color:
      a. Background: Grayed-blue.
      b. Lettering: White.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install interior signs square and plumb.
   1. Room Signs:
      a. Install bracket using two screws. Use proper anchor for substrate.
      b. Attach sign to bracket using set-screw.

END OF SECTION

SECTION 10 2813

COMMERCIAL TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:
   1. Selected accessories for Rest Rooms.
   2. Custodial Area accessories.

B. Related Requirements:
   1. Section 01 1200: Soap dispensers, paper towel dispensers, and toilet tissue dispensers furnished and installed by the Owner.
   2. Section 06 1100: Blocking.
   3. Section 06 2001: Installation.

1.2 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings: Schedule showing items used, location where installed, and proper attaching devices for substrate.

B. Closeout Submittals:
   1. Operations And Maintenance Data: Include manufacturer's literature or cut sheets in Operations And Maintenance Manual specified in Section 01 7800.
   2. Warranty Documentation: Include final, executed warranty in Operations And Maintenance Manual specified in Section 01 7800.

1.3 WARRANTY

A. Manufacturer's standard warranty against rusting.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:
   1. Manufacturer List:
      a. A & J Washroom Accessories, New Windsor, NY www.ajwashroom.com.
      b. American Accessories Inc (AAI), Denison, TX www.aaiusaonline.com.
      c. American Specialties Inc (ASI), Yonkers, NY www.americanspecialties.com.
      d. Bobrick Washroom Equipment Inc, North Hollywood, CA www.bobrick.com.
      e. Bradley Corp, Menomonee Falls, WI www.bradleycorp.com.
      f. General Accessory Manufacturing Co (GAMCO), Durant, OK www.gamcousa.com.

B. Materials:
   1. Approved Products.
      a. Rest Rooms:
         1) Single Robe Hook with Exposed Fasteners:

A & J	AAI	ASI	Bobrick	Bradley	GAMCO
UX110B	OR-B5153	7340B	B-671	9114	5153B

2) Mirrors: Glass with stainless steel channel frame with No. 4 Satin finish.

A & J	AAI	ASI	Bobrick	Bradley	GAMCO
U711	CA Series	0620	B-165	700 Series	C Series

3) Grab Bars:
   a) Concealed mount, 18 ga, type 304 stainless steel, 1-1/2 inch diameter, and non-slip finish in configuration shown on Drawings.

4) Shelf: 18 ga , stainless steel with No. 4 Satin finish, 6 inches wide.

A & J	AAI	ASI	Bobrick	Bradley	GAMCO
U775	WV-6	0692	B-296	756	S-6

b. Custodial Rooms:

1) Utility Shelf: Size as shown on Drawings.

A & J	AAI	ASI	Bobrick	Bradley	GAMCO
UJ13	MN Series	1300 Series	B-224 Series	9933 Series	US Series

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install using mounting devices proper for base structure.

B. Where possible, mount like items in adjoining compartments back-to-back on same partition.

END OF SECTION

DIVISION 22
PLUMBING

220100 GENERAL REQUIREMENTS FOR PLUMBING
220500 BASIC MATERIAL AND METHODS FOR PLUMBING
220519 METERS AND GAGES FOR PLUMBING PIPING
220523 GENERAL-DUTY VALVES FOR BOILER ROOM PIPING
220548 VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
220553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220700 PLUMBING INSULATION
221116 DOMESTIC WATER PIPING
221119 DOMESTIC WATER PIPING SPECIALTIES
221316 SANITARY WASTE AND VENT PIPING
221319 SANITARY WASTE PIPING SPECIALTIES
221413 STORM DRAINAGE PIPING
221423 STORM DRAINAGE PIPING SPECIALTIES
221513 AIR ATOMIZATION PIPING
223100 WATER SOFTENERS
224000 PLUMBING FIXTURES
224500 EMERGENCY PLUMBING FIXTURES
224700 DRINKING FOUNTAINS AND WATER COOLERS

SECTION 220100 - GENERAL REQUIREMENTS FOR PLUMBING

PART 1 - GENERAL

1.1 GENERAL

A. General Conditions and Division 01 apply to this Division.

1.2 SCOPE

A. Includes -

1. Furnish all labor, materials, and equipment necessary for the completion of the mechanical and plumbing scope of work associated with installation of a new boiler plant and all associated items, piping, controls the connection of new steam, condensate, water and oil piping into existing.
2. Furnish and install all motors specified in this Division and be responsible for the proper operation of electrical powered equipment furnished by this Division.
3. Furnish exact location of electrical connections and information on motor controls to Division 16.
4. Mechanical Contractor shall obtain the services of independent Test and Balance Agency for the balance of condensate and boiler feed water pumps and furnace system.
5. Placing the new boilers, boiler feedwater, condensate and make-up system and controls into full operation and continuing operation during each working day of testing.
6. The satisfactory performance of the completed systems is a requirement of this specification.

B. Related Work Specified Elsewhere

1. Conduit, line voltage wiring, and disconnect switches specified in Division 16.

1.3 SITE OBSERVATION

A. The Contractor shall examine the existing boiler plant and the proposed site for the new boiler plant and understand the conditions which may affect the performance of work of this Division before submitting proposals for this work.

B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

1.4 DRAWINGS

A. Mechanical drawings show general arrangement of the boilers, deaerator feedwater system, condensate return and transfer system, gas and oil and heating and cooling system, plumbing system, blowdown system, controls system, piping; however, locations are to be regarded as shown diagrammatically only. Follow as closely as actual building construction and work of other trades will permit.

B. Because of the small scale of mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate structural and finished conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

C. If changes in location of piping, equipment, etc. are required due to lack of coordination of work under this division, such changes shall be made without charge. Contractor shall review drawings with USDC and state agencies having jurisdiction and any changes required by them shall be brought to the attention of the Engineer prior to bidding or commencement of work.

D. Contractor shall be responsible for contacting and setting up inspections for the state inspector and state boiler inspector.

1.5 CODE REQUIREMENTS, FEES, AND PERMITS

A. The work shall be installed in accordance with the following applicable codes, ordinances and standards unless otherwise specified. The codes and standards shall include but not be limited to and be of the latest and current editions.

1. American Boiler and Affiliated Industries (AB and AI)
2. American Gas Association (AGA)
3. American National Standards Institute (ANSI)
4. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) - ASHRAE 90.1-2006
5. American Society of Mechanical Engineers (ASME)
6. American Society of Testing Materials (ASTM)
7. American Standards Association (ASA)
8. American Water Works Association (AWWA)
9. American Welding Society (AWS)
10. Associated Air Balance Council (AABC)(NEBB)
11. Heat Exchange Institute (HEI)
12. Hydraulic Institute (HI)
13. National Electrical Code (NEC)
14. National Fire Protection Association (NFPA)
15. Underwriters Laboratories (UL)
16. International Building Code (IBC) 2006 Ed
17. International Mechanical Code (IMC) 2006 Ed
18. International Plumbing Code (IPC) with Utah Amendments 2006 Ed\
19. International Energy Conservation Code (IECC) 2006 Ed

20. Utah State Safety Orders (OSHA/UOSH)
21. Utah Fire Rating Bureau
22. Utah Boiler and Pressure Vessel Law
23. Utah Air Conservation Regulations/Waste Disposal regulations.
24. ASH RAE Ventilation STD .62-2006
25. DFCM and USDC Standards.

B. Should drawings conflict with any code, the code shall govern. If drawings and specifications establish a quality exceeding the code, the drawings and specifications shall govern. If conflicts do exist among the drawings, specifications and codes, the same shall be brought to the attention of the Architect in writing prior to bidding; otherwise Contractor shall comply with applicable codes.

C. The latest edition of all codes shall be used.

1.6 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS

A. Upon completion of work and before final payment, Contractor shall furnish and deliver to the Owner, through the Architect and Engineer, installation, operation and maintenance manuals with instructions for all new materials and equipment used in the building. The contractor shall provide three (3) hard copies of the manuals, and three (3) CD's with electronic copies of the manuals. Electronic information shall be .PDF format. The CD's shall include the same information as the hard copies, and shall be organized in the same manner with electronic bookmarks for each section. CD case and the CD itself shall be labeled the same as the hard copies of the manuals.

B. Bind Operation and Maintenance Manual in a hard-backed piano hinge loose-leaf binder with strong sturdy cover. The project name shall be on the spine and the front of the binder. The front of the binder shall include the following information:

OPERATION
AND
MAINTENANCE
MANUAL
for MECHANICAL SYSTEMS of
(Name of Project)
(Location of Project)
(Date of Project Award)
(Name of Architect)
(Name of Engineer)

C. Introduction

1. Title page including name of project, project number, date awarded and date of substantial completion.
2. Second page shall contain the names, phone numbers and addresses of Architect, Consulting Engineers, and Mechanical Contractor.
3. Third page shall include a Table of Contents for the entire manual.

D. First Section - Summary information including:

1. First page shall contain the contractor's warranties.
2. Second page shall contain a list of names, addresses and phone numbers of contractors and all sub-contractors and work to which each was assigned.
3. Final page or pages shall contain an equipment list of all new equipment, etc. list shall contain equipment numbers, make and model number, Serial No. Identification No. and name, address, and phone number of the supplier.

E. Second Section - Mechanical Equipment O&M data including:

1. Mechanical maintenance schedule, including a lubrication list when necessary.
2. Mechanical Equipment Operation and Maintenance Data including:

   a. Equipment descriptions
   b. Detailed installation instruction, operating and maintenance instructions. Instructions include in a step by step manner identifying start-up, operating, shutdown and emergency action sequence sufficiently clear so a person unfamiliar with the equipment could perform its operations.
   c. Equipment drawings, performance curves, operating characteristics, etc.
   d. Name addresses and phone number of manufacturer, fabricator and local vender clearly printed or stamped on cover.
   e. Complete parts listing which include catalog number, serial number, contract number or other accurate provision for ordering replacement and spare parts.
   f. Certified drawings, where applicable, showing assembly of parts and general dimensions.

3. Approved Mechanical submittals

F. Third Section - Controls O&M data including:

1. Sequence of Operation
2. Description of Boiler control system included location of all control devices. Describe all alarms and cautions for operation.
3. Provide schematic control diagrams, panel diagrams, wiring diagrams, etc. for boilers and all associated systems.

G. Fourth Section - Plumbing Equipment O&M data including:

1. Section shall contain general product catalog cuts, as well as exploded view drawings with parts lists for all valves and other items with multiple parts.
2. Approved Plumbing submittals

H. The Fifth Section shall contain a complete test and balance report. The report shall contain the name, address and phone number of the agency. It shall also include:

1. Test and Balance of condensate transfer system testing of feed water system.
2. Testing of Boiler and Controls.
3. Test and Balance of heating and cooling furnace system.
4. Testing of Boilers - see section 15518.

I. Drawings and reproducible masters of drawings as required in individual specification sections, are not to be bound in volumes but are to be delivered separate with the maintenance manuals.

J. See the following checklist for assistance in assembling manual:

Item #	**Description**	**Y, N, or NA**
1	3 ring heavy duty binder with Project name, number and date on cover and project name on spine.	
2	O&M manual on CD (with label on CD matching label on manual). Electronic copy shall be a PDF file with bookmarks that match the tabs in the hard copy.	
3	Title Page [including project name, number, address, date awarded, date of substantial completion]	
4	Second Page Contact List [including architects, mechanical engineer, consulting engineer, and mechanical contractor]	
5	Table of Contents	
6	**Section 1 - Summary**	
A	Warranty	
B	Mechanical's Sub-contractor List	
C	Vendor List	
D	Equipment List	
7.	**Section 2 – Mechanical Equipment**	
A	Maintenance Schedule (including lubrication list)	
B	Mechanical Equipment O&M Data (for each piece of equipment submitted) per specifications	
C.	Approved mechanical submittals	
8.	**Section 3 - Controls**	
A	Sequence of Operation	
B	Controls diagrams	
9.	**Section 4 – Plumbing Equipment**	
A	Plumbing equipment O&M data	
B	Approved plumbing submittals	
C.	Controls Equipment	
10.	**Section 5 – Test Report**	
A.	Complete Test Report per specifications	

1.7 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Contractor shall instruct building maintenance personnel in the operation and maintenance of the new installed boilers and systems utilizing the Operation and Maintenance Manual when so doing.

B. Minimum instruction periods shall be 8 hours -

1. Four hours in classroom setting.
2. Four hours in boiler room with hands on instructions.

C. Instruction periods shall occur before final site observation when all systems are properly working and before final payment is made.

D. An additional four hours of instruction will be provided by each contractor, after 60 days of system operation by owner to insure proper system operation and answer questions.

1.8 RECORD DRAWINGS

A. Contractor shall keep an up-to-date set of contract drawings in his custody showing all changes in red, clearly defined and neatly drafted by him. At the end of construction, he shall turn these drawings over to the Engineer. Record drawings must be completed and submitted prior to final site observation

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PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION 220100

SECTION 220500 - BASIC MECHANICAL MATERIALS AND METHODS FOR PLUMBING

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. Piping materials and installation instructions common to most piping systems.
2. Mechanical demolition.
3. Equipment installation requirements common to equipment sections.
4. Painting and finishing.
5. Concrete bases.
6. Supports and anchorages.

1.3 SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

B. All materials, piping, etc. shall be new, and domestically made of the best commercial quality obtainable, consistent with specified materials and for the purpose or function intended unless specifically approved in writing prior to bid.

1.5 DELIVERY, STORAGE, AND HANDLING

A. 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.

1.6 COORDINATION

A. Coordinate installation of required supporting devices with existing structural components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE AND FITTINGS

A. Refer to individual Division 15 piping Sections for piping, and fitting materials and joining methods.

B. Pipe Threads: ASME B1 .20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 300 and 250, cast-iron and steel flanges.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

A. Disconnect, demolish, and remove existing water, steam oil and condensate return piping in existing tunnel that will not be reused in new boiler plant.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

B. If pipe or insulation, to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Drawings do not show every offset, or bend that may be required. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping at right angles and parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Verify final equipment locations for roughing-in.

K. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment or boiler connection.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment or boiler connection.

3.5 BOILER, PUMPS AND ECONOMIZER INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems
and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of mechanical systems, equipment, and components shall be as specified in
these specifications. See section 15075.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. See structural drawings.
2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base or wall and anchor into structural concrete floor or wall.
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. See structural drawings.

END OF SECTION 220500

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Thermowells.
5. Dial-type pressure gages.
6. Gage attachments.

1.3 SUBMITTALS

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

B. Product Certificates: For each type of meter and gage, from manufacturer.

C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Inc.
2. Marsh Bellofram.
3. Miljoco Corporation.
4. Palmer Wahl Instrumentation Group.
5. Trerice, H. O. Co.
6. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
7. Weiss Instruments, Inc.
8. Prior approved equal.

B. Standard: ASME B40.200.

C. Case: sealed type; stainless steel with 3-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type: Union joint, adjustable angle for direct mounting and rigid, with unified-inch screw threads. For panel mounted.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

M. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AMETEK, Inc.; U.S. Gauge.
   b. Ashcroft Inc.
   c. Marsh Bellofram.
   d. Miljoco Corporation.
   e. Palmer Wahl Instrumentation Group.
   f. Trerice, H. O. Co.
   g. Weiss Instruments, Inc.
   h. Prior approved equal.

2. Standard: ASME B40.200.
3. Case: Sealed type, drawn steel; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.
8. Window: Glass.
9. Ring: Stainless steel.
10. Connector Type(s): Union joint, back; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

a. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

N. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Miljoco Corporation.
   b. Palmer Wahl Instrumentation Group.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.
   e. Prior approved equal.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.

   a. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Steel Piping: CRES or CSA.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1 .1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem. Min half way into piping.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ashcroft Inc.
   b. Miljoco Corporation.
   c. Palmer Wahl Instrumentation Group.
   d. Trerice, H. O. Co.
   e. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   f. Weiss Instruments, Inc.
   g. Prior approved equal.

2. Standard: ASME B40.100.
3. Case: Sealed type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ashcroft Inc.
   b. Marsh Bellofram.
   c. Miljoco Corporation.
   d. Palmer Wahl Instrumentation Group.
   e. Trerice, H. O. Co.
   f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   g. Weiss Instruments, Inc.
   h. Prior approved equal.

2. Standard: ASME B40.100.
3. Case: Sealed type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.

8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels for boiler feed water inlet connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length. Mount in finished cabinet and attach the panel to the structural supports.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install valve and snubber in piping for each pressure gage for fluids.

I. Install thermometers in the following locations:

1. Where shown on drawings.

J. Install pressure gages in the following locations:

1. Where shown on drawings.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each fuel-oil pump.
4. Suction and discharge of each pump.

3.2 ADJUSTING

A. Adjust faces of thermometers and gages to proper angle for best visibility. For direct mounted.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping: 0 to 160 deg F.

C. Scale Range for boiler feed water: 0 to 300 deg F.

D. Scale Range for Condensate: 0 to 300 deg F.

E. Scale Range for Stack: 0 to 700 deg F.

F. Scale Range for Steam Piping: 0 to 400 deg F.

3.4 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Oil Piping: -10 to 200 psig.

B. Scale Range for Boiler feed water Piping: 0 to 150 psig.

C. Scale for Condensate Piping: 0 to 150 psig.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR BOILER ROOM PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron ball valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Bronze gate valves.
8. Iron gate valves.
9. Iron globe valves.
10. Lubricated plug valves, Natural gas piping only. 11. Chainwheels.

B. Related Sections:

1. Division 15 piping Sections for specialty valves applicable to those Sections only.
2. Division 15 Section "Identification for Piping and Equipment".

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31 .1 for power piping valves.
3. ASME B31 .9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.
3. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for each size square plug-valve head.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Hammond Valve.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Prior approved equal.

2. Description:

   a. Standard: MSS SP-1 10.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Forged brass.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Brass.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

B. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim: Steam Only.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Hammond Valve.
   d. Jamesbury; a subsidiary of Metso Automation.
   e. Kitz Corporation.
   f. Milwaukee Valve Company.
   g. Prior approved equal.

2. Description:

   a. Standard: MSS SP-1 10.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Forged brass.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

C. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Jomar International, LTD.
   b. Kitz Corporation.
   c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   d. Prior approved equal.

2. Description:

   a. Standard: MSS SP-1 10.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Three piece.
   e. Body Material: Forged brass.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Brass.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

D. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim: Steam only.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Jomar International, LTD.
   b. Kitz Corporation.
   c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   d. Prior approved equal.

2. Description:

   a. Standard: MSS SP-1 10.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Three piece.
   e. Body Material: Forged brass.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American Valve, Inc.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Crane Co.; Crane Valve Group; Crane Valves.
   d. Hammond Valve.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Prior approved equal.

2. Description:

   a. Standard: MSS SP-1 10.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Steam only.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Prior approved equal.

2. Description:

   a. Standard: MSS SP-1 10.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Conbraco Industries, Inc.; Apollo Valves.
   b. DynaQuip Controls.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Prior approved equal.

2. Description:

   a. Standard: MSS SP-1 10.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Three piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

D. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Steam only.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc.; Apollo Valves.
    b. Hammond Valve.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. Prior approved equal.

2. Description:

    a. Standard: MSS SP-1 10.
    b. SWP Rating: 150 psig.
    c. CWP Rating: 600 psig.
    d. Body Design: Three piece.
    e. Body Material: Bronze.
    f. Ends: Threaded.
    g. Seats: PTFE or TFE.
    h. Stem: Stainless steel.
    i. Ball: Stainless steel, vented.
    j. Port: Full.

2.4 IRON BALL VALVES

A. Class 300, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Valve, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. Kitz Corporation.
    d. Sure Flow Equipment Inc.
    e. Prior approved equal.

2. Description:

    a. Standard: MSS SP-72.
    b. CWP Rating: 200 psig.
    c. Body Design: Split body.
    d. Body Material: ASTM A 126, gray iron.
    e. Ends: Flanged.
    f. Seats: PTFE or TFE.
    g. Stem: Stainless steel.
    h. Ball: Stainless steel.
    i. Port: Full.

2.5 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Valve, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Kitz Corporation.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Prior approved equal.

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.6 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Kitz Corporation.
   f. Legend Valve.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Powell Valves.
   j. Prior approved equal.

2. Description:

   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. Body Design: Clear or full waterway.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.

f. Trim: Bronze.
g. Gasket: Asbestos free.

B. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Prior approved equal.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.

2.7 BRONZE GATE VALVES

A. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.
b. Kitz Corporation.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Powell Valves.
f. Prior approved equal.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.

h. Handwheel: Malleable iron.

B. Class 150, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Prior approved equal.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

2.8 IRON GATE VALVES

A. Class 300, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. NIBCO INC.
d. Powell.
e. Prior approved equal.

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

B. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Powell Valves.
   g. Prior approved equal.

2. Description:

   a. Standard: MSS SP-70, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Trim: Bronze.
   f. Disc: Solid wedge.
   g. Packing and Gasket: Asbestos free.

2.9 LUBRICATED PLUG VALVES - NATURAL GAS ONLY:

A. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Nordstrom Valves, Inc.
   b. Prior approved equal.

2. Description:

   a. Standard: MSS SP-78, Type II.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
   d. Pattern: Regular.
   e. Plug: Cast iron or bronze with sealant groove.

2.10 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.

3. Trumbull Industries.
4. Prior approved equal.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to gate valve stems. Over 96” above floor.
3. Sprocket Rim with Chain Guides: Cast iron, of type and size required for valve.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling. This includes valves supplied by contractor and vavles supplied by equipment manufacturers.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage. Make sure all flanged are two-holed with bolt holes at equal distance from top of pipe center line.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment or connections to boiler piping. Arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for gate and globe valves NPS 3 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service except Steam: Globe ball or butterfly valves.
4. Throttling Service, Steam: Globe valves.
5. Pump-Discharge Check Valves:

a. Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Steel Piping, NPS 2 and Smaller: Threaded ends.
2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
3. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 BOILER FEED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 250, bronze disc.
4. Bronze Gate Valves: Class 250, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: Flanged ends.
2. Iron Swing Check Valves: Class 250, metal seats flanged ends.
3. Iron Gate Valves: Class 250, NRS flanged ends.
4. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 250 flanged ends.

3.6 HIGH-PRESSURE STEAM VALVE SCHEDULE MORE THAN 15 PSIG

A. Pipe NPS 2 and Smaller: Threaded.

1. Ball Valves: Three piece, full port, brass or bronze with brass or bronze trim.
2. Bronze Swing Check Valves: Class 250, bronze disc.
3. Bronze Gate Valves: Class 250, RS, bronze.
4. Globe Valves: Class 250, bronze, disc.

B. Pipe Sizes NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 6: Class 300 Iron - Shall be flanged.
2. Ball Valves, NPS 2-1/2 to NPS 10: Class 300, iron flanged.
3. High-Performance Butterfly Valves: Class 300, double flange.
4. Iron Gate Valves: Class 300, NRS flanged.
5. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 300 flanged.

3.7 STEAM-CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Angle Valves: Class 300, bronze disc.
2. Ball Valves: Three piece, full port, brass or bronze with brass or bronze trim.
3. Bronze Swing Check Valves: Class 300, bronze disc.
4. Bronze Gate Valves: Class 300, RS.
5. Bronze Globe Valves: Class 300, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 6: Shall be flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 300 flanged.
3. High-Performance Butterfly Valves: Class 300, single flange flanged.
4. Iron Gate Valves: , NRS flanged.
5. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 300 flanged.

END OF SECTION 220523

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND 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 the following:

1. Pipe riser resilient supports.
2. Seismic snubbers.
3. Restraining braces and cables.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: 100 MPH or Per owner's design standards.
2. Building Classification Category: As defined in the IBC.
3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Site Class: As defined in the IBC.
2. Assigned Seismic Use Group or Building Category: As defined in the IBC.

   a. Component Importance Factor: 1.5.

1.5 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. Hilti, Inc.
3. Kinetics Noise Control.
4. Mason Industries.
5. Unistrut; Tyco International, Ltd.
6. Prior approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

E. Restraint Cables: -steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of

neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Comply with structural drawings for installation of equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. 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.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
3. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION PLUMBING PIPING AND 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 the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment signs.
3. Pipe markers.

1.3 SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, and viewing angles of identification devices for piping. Comply with color scheme attached to this section.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Provided and installed by equipment manufacturer. Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

a. Manufacturer, product name, model number, and serial number.
b. Capacity, operating and power characteristics, and essential data.
c. Manufacturer equipment date.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Signs: Provided and installed by contractor. ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Equipment, symbol, capacity etc i.e. (BFP-1, gpm @ psi, HP, 208/60/3phase).
2. Engraving: Manufacturer's standard letter style, 1/4” or larger with terms to match equipment identification.
3. Thickness: 1/8 inch, unless otherwise indicated.
4. Fasteners: Self-tapping, stainless-steel screws adhesives not allowed.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Piping shall be painted throughout to match existing pipe painting.
2. Colors: Comply with WSU, unless otherwise indicated.
3. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Manufacturer shall provide and install equipment nameplates. Manufacturer shall install
and permanently fasten equipment nameplates on all equipment. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

B. Equipment signs provided and installed by Contractor shall be attached to equipment with screws (adhesives are not acceptable) on or near each major item of mechanical equipment. Locate signs where accessible and visible.

1. Identify mechanical equipment with black equipment markers with white lettering.
2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
3. Data: Indicate operational requirements, ie equipment symbol; psi, HP, electrical.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

B. Locate pipe markers and color bands where accessible and easily seen:

1. Near each valve and control device.
2. Where flow pattern is not obvious.
3. Near major equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

3.4 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.5 CLEANING

A. Clean faces of mechanical identification devices.

END OF SECTION 220553

SECTION 220700 - PLUMBING 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. Section Includes: Insulation of steam, condensate, FGR piping, chemical feed, boiler feed water, water piping (hot and cold), and roof drain piping.

1. Insulation Materials:

   a. Calcium silicate.
   b. Mineral fiber.

2. Insulating cements.
3. Adhesives.
4. Lagging adhesives.
5. Factory-applied jackets.
6. Field-applied jackets.
7. Tapes.
8. Securements.
9. Corner angles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets.

B. Qualification Data: For qualified Installer.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Store insulation in a protective and dry environment.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Calcium Silicate:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Industrial Insulation Group (The); Thermo-12 Gold.
b. Prior approved equal.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in performing insulation to cover valves, elbows, tees, and flanges. Covers shall be able to withstand 100 psi steam temperature.

D. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Micro-Lok.
b. Owens Corning; Fiberglas Pipe Insulation.
c. Knauf Insulation; 1000 Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Fibrex Insulations Inc.; Coreplus 1200.
f. Prior approved equal.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
c. Prior approved equal.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-97.
b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
c. Marathon Industries, Inc.; 290.
d. Mon-Eco Industries, Inc.; 22-30.

e. Vimasco Corporation; 760.
f. Prior approved equal.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.
f. Prior approved equal.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-52.
b. Foster Products Corporation, H. B. Fuller Company; 8 1-42.
c. Marathon Industries, Inc.; 130.
d. Mon-Eco Industries, Inc.; 11-30.
e. Vimasco Corporation; 136.
f. Prior approved equal.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.5 FACTORY-APPLIED JACKETS

A. Insulation system shall have factory-applied jackets, factory-applied jackets shall comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated. Provide jackets on steam piping, condensate piping, boiler feedwater piping,

stacks, vertical drops 8’ - 0” up on rainwater drops and any insulation that could be

damaged.

B. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products, Division of ITW; Metal Jacketing Systems.
   b. PABCO Metals Corporation; Surefit.
   c. RPR Products, Inc.; Insul-Mate.
   d. Prior approved equal.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

   a. Sheet and roll stock ready for shop or field sizing.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
   d. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
   b. Compac Corp.; 104 and 105.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   e. Prior approved equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   b. Compac Corp.; 110 and 111.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
   d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
   e. Prior approved equal.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   b. Compac Corp.; 120.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
   d. Venture Tape; 3520 CW.
   e. Prior approved equal.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.
   d. Prior approved equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide.

3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide.

2.9 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface. Calcium silicate insulation shall be under PVC corner covering.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Mix insulating cements with clean potable water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of stack, piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of stacks and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top when looking up and bottom when looking down of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and any penetrations in insulation with vapor-barrier mastic.

1. Install insulation continuously through hangers i.e. hangers on outside of insulation and around anchor attachments.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. Do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Handholes.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Terminate insulation before roof penetrations.

1. For applications requiring only indoor insulation, terminate insulation below roof surface and seal with joint sealant.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. Label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.6 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Boiler Stack:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.

2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals. Finish with a metal jacket.
3. Minimum insulation thickness 4 inches.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

1. Where metal jackets are indicated, install per manufacturers recommendations,

3.9 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Boiler Breeching:

1. Calcium Silicate: 4 inches thick.

C. Deaerator Tank:

1. Calcium Silicate: 3 inches thick.

D. Condensate Tank

1. Calcium Silicate: 3 inch thick.

E. Provide Metal Jacket.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping and intermitten blowdown piping.
2. Fuel oil piping.
3. Natural Gas Piping.
4. Steam traps and trap piping.

C. Piping System insulation:

1. Boiler Feed Water Piping - Mineral Fiber or calcium silicate, per chart.
2. Domestic Water Piping -Mineral Fiber, per chart.
3. Chemical feed piping - Mineral Fiber, 1”.
4. Continuous blowdown piping - mineral fiber 2 1/2”.
5. Steam piping - mineral fiber/calcium silicate: per chart.
6. Condensate Piping - Mineral Fiber/Calcium Silicate: Per chart.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Minimum Pipe Insulation Thickness from ANSI/ASHRAE/IESNA Standard 90.1-2004

Fluid Design Operating Temp. Range (°F	**Insulation Conductivity**		**Nominal**				
	Conductivity Btu.in./(h.ft2.°F)	**Mean Rating Temp. °F**	**<1**	**1 to <1-1/2**	**1-1/2 to <4**	**4 to <8**	**?8**
Heating Systems (Steam, Steam Condensate, and Hot Water)							
>350	0.32-0.34	250	2.5	3.0	3.0	4.0	4.0
251-350	0.29-0.32	200	1.5	2.5	3.0	3.0	3.0
201-250	0.27-0.30	150	1.5	1.5	2.0	2.0	2.0
141-200	0.25-0.29	125	1.0	1.0	1.0	1.5	1.5

105-140	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Domestic and Service Hot Water Systems							
105+	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Cooling Systems (Chilled Water, Brine, and Refrigerant)							
40-60	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
<40	0.22-0.28	100	0.5	1.0	1.0	1.0	1.5

3.12 INDOOR, FIELD-APPLIED METAL JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Exposed:

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Culinary water piping for toilet room and plumbing fixtures i.e. hose bibs, service sink etc.
2. Culinary water piping for sample cooler.
3. Culinary water piping for blowdown separator.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to 2006 IBC.

1.4 QUALITY ASSURANCE

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

B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube,hard drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.

2. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. EPCO Sales, Inc.
   d. Hart Industries International, Inc.
   e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   f. Zurn Plumbing Products Group; Wilkins Water Control Products.
   g. Prior approved equal.

2. Description:

   a. Pressure Rating: 150 psig at 180 deg F.
   b. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Install shutoff valve immediately upstream of each dielectric fitting.

B. Install domestic water piping level without pitch and plumb.

C. Install piping at right angles and parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping adjacent to equipment and specialties to allow service and maintenance.

E. Install piping to permit valve servicing.

F. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 15 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve where required. Use ball valves.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

C. Support vertical piping and tubing at base.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

3.6 CONNECTIONS

A. Install piping adjacent to equipment and machines to allow service and maintenance.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 15 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

a. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill new domestic water piping and new joints. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Cap and subject new piping to static water pressure of 100 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 CLEANING

A. Clean and disinfect new potable domestic water piping as follows:

1. Purge new piping before using.
2. Use purging and disinfecting procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:

      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.10 PIPING SCHEDULE

A. Unions may be used for aboveground piping joints unless otherwise indicated.

B. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.

3.11 VALVE SCHEDULE

A. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, ball for piping NPS 2-1/2 and larger.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING 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 domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Strainers.
5. Hose bibbs.
6. Drain valves.
7. Air vents.
8. Trap-seal primer valves.
9. Trap-seal primer systems.
10. Outlet Boxes

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ames Co.
   b. Cash Acme.
   c. Con braco Industries, Inc.
   d. FEBCO; SPX Valves & Controls.
   e. Watts Industries, Inc.; Water Products Div.
   f. Zurn Plumbing Products Group; Wilkins Div.
   g. Prior approved equal.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Arrowhead Brass Products, Inc.
   b. Cash Acme.
   c. Con braco Industries, Inc.
   d. MIFAB, Inc.
   e. Watts Industries, Inc.
   f. Woodford Manufacturing Company.
   g. Zurn.
   h. Prior approved equal.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1 .20.7.
5. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. BEECO.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.
   e. Watts Industries, Inc.
   f. Zurn.
   g. Prior approved equal.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller;
6. End Connections: Threaded for NPS 2 and smaller.
7. Accessories:

   a. Valves: Ball type with threaded ends on inlet and outlet.
   b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Watts Industries, Inc.; Water Products Div.
   b. Conbraco Industries, Inc.
   c. Zurn.
   d. Cash Acme.
   e. Prior approved equal.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.

2. Body: Bronze for NPS 2 and smaller.
3. End Connections: Threaded for NPS 2 and smaller.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Drain: Factory-installed, hose-end drain valve.

2.5 HOSE BIBBS

A. Manufacturers:

a. Woodford Manufacturing Company.
b. Zurn.
c. Smith, Jay R.

B. Hose Bibbs:

1. Standard: ASME A1 12.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: 3/4 threaded inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1 .20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Operation for Equipment Rooms: Wheel handle.
10. Include integral wall flange for hose bibb in work room area.

2.6 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MIFAB, Inc.
b. PPP Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Watts Industries, Inc.; Water Products Div.
f. Prior approved equal.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig (860 kPa) minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.

7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is

not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   b. Prior approved equal.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.7 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. PPP Inc.
   b. Prior approved equal.

2. Standard: ASSE 1044,
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Surface-mounting steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
6. Vacuum Breaker: ASSE 1001.
7. Size Outlets: NPS 1/2.

2.8 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Guy Gray Manufacturing Co., Inc.
   b. Acorn Engineering Company.
   c. Symmons Industries, Inc.
   d. Watts Industries.
   e. Zurn.
   f. Prior approved equal.

2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.

4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A1 12.18.1. Include garden-hose thread complying with ASME B1 .20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve.

E. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

F. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Water pressure-reducing valves.
4. Supply-type, trap-seal primer valves.
5. Trap-seal primer systems.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Sections:

1. Division 2 Section "Sanitary Sewerage" for sanitary sewerage piping and structures 5’ - 0” outside the building.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping above floor and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Piping materials shall be made in USA and bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS: Underfloor and Special Fittings.

A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS ABOVE FLOOR

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings: Above Floor.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ANACO-Husky.
   b. Dallas Specialty & Mfg. Co.
   c. Fernco Inc.
   d. Matco-Norca, Inc.
   e. MIFAB, Inc.
   f. Mission Rubber Company; a division of MCP Industries, Inc.
   g. Stant.
   h. Tyler Pipe.
   i. Prior approved equal.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method. Use for vents and stub-thru-wall.

B. Cast-Iron Drainage Fittings: ASME B16.12, threaded.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Dallas Specialty & Mfg. Co.
      2) Fernco Inc.
      3) Mission Rubber Company; a division of MCP Industries, Inc.
      4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
      5) Prior approved equal.

   b. Standard: ASTM C 1173.
   c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. Sleeve Materials:

      1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 2 Section "Earthwork."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated.

C. Install piping above accessible ceilings to allow sufficient space for ceiling panel

removal.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install seismic restraints on piping above floor. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

M. Install steel piping according to applicable plumbing code.

N. Install underground PVC piping outside building (only) according to ASTM D 2321.

O. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

P. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Division 15 Section "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 15 Section "Sanitary Waste Piping Specialties."

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, and floors. Comply with requirements for sleeves specified in Division 15 Section "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 15 Section "Sleeves and Sleeve Seals for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping underfloor with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping above floor according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Plastic, Nonpressure-Piping, Solvent-Cement Joints for underground piping exterior to building: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded, nonpressure transition couplings.

   a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
   b. NPS 2 and Larger: Pressure transition couplings.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping above floor.

B. Comply with requirements for pipe hanger and support devices and installation specified in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

5. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for galvanized steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Support piping not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping 5’ - 0” outside building. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for cleanouts and drains specified in Division 15 Section "Sanitary Waste Piping Specialties."

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 15 Section "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, minimum 1 HR water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints for venting.

B. Aboveground, vent piping NPS 4 and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.

C. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:

1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints. Exterior, underground use only.
3. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING 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 sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Trench drains.
4. Roof flashing assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer, rated capacities, operating characteristics, and accessories for the following:

1. Cleanouts.
2. Floor drains.
3. Trench drains.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency. All specialties shall be made in the USA.

1.5 COORDINATION

A. Coordinate size and location of roof vent penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
   g. Prior approved equal.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Light Commercial Operation.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.
   h. Prior approved equal.

2. Standard: ASME A1 12.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Threaded.
8. Closure: Cast-iron plug.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
   g. Prior approved equal.

2. Standard: ASME A1 12.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe.
   e. Watts Drainage Products Inc.
   f. Zurn.
   g. Prior approved equal.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Top or Strainer Material: Nickel - Bronze.
8. Top Shape: Round.
9. Top Loading Classification: Medium Duty.
10. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
11. Trap Pattern: P-trap.
12. Trap Features: Trap-seal primer valve drain connection.

2.3 TRENCH DRAINS

A. Trench Drains: Formed in floors by General Contractor. Mechanical contractor shall provide cast iron dome drains in floor of trench drains.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam.
   b. MIFAB, Inc.
   c. Smith.
   d. Tyler Pipe.
   e. Watts.
   f. Zurn.
   g. Prior approved equal.

2. Material: Cast iron.
3. Flange: Anchor.
4. Clamping Device: Required.
5. Outlet: As indicated on drawings.
6. Grate Material: by others.
7. Dimensions of Frame and Grate: As indicated on drawings.
8. Top Loading Classification: Heavy Duty.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.
   c. Prior approved equal.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

2.6 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51 121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. Vent Pipe Flashing: 8 oz./sq. ft. thickness.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained except for furnace drain. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.

2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain.

E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece. Join flashing according to the following if required:

1. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.

C. Secure flashing into sleeve and specialty clamping ring or device.

D. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 7 Section "Sheet Metal Flashing and Trim."

E. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221413 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Sections:

1. Division 2 Section "Storm Drainage" for storm drainage piping outside the building.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 See section 15074.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

B. Piping and materials shall be made in the USA.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service classes.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Tyler Pipe.
   b. ANACO-Husky.
   c. Dallas Specialty & Mfg. Co.
   d. Fernco Inc.
   e. Matco-Norca, Inc.
   f. MIFAB, Inc.
   g. Prior approved equal.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Tyler Pipe.
   b. ANACO-Husky.
   c. Clamp-All Corp.
   d. Dallas Specialty & Mfg. Co.
   e. MIFAB, Inc.
   f. Prior approved equal.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

4. Standard: ASTM C 1277.
5. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Seamless, Standard Weight. Include square-cut-grooved or threaded ends matching joining method.

B. Cast-Iron Drainage Fittings: ASME B16.12 threaded.

C. Cast-Iron Flanges: ASME B16.1, Class 125.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.5 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, hard drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast-copper fittings or ASME B16.29, wrought-copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.6 PVC PIPE AND FITTINGS (Underground)

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Solvent Cement: ASTM D 2564.

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Unshielded, Nonpressure Transition Couplings:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Dallas Specialty & Mfg. Co.
      2) Fernco Inc.
      3) Mission Rubber Company; a division of MCP Industries, Inc.
      4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
      5) Prior approved equal.

   b. Standard: ASTM C 1173.
   c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. Sleeve Materials:

      1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 2 Section "Earthwork."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping indicated to be exposed at right angles and parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

C. Install piping at indicated slopes.

D. Install piping free of sags and bends.

E. Install fittings for changes in direction and branch connections.

F. Install piping to allow application of insulation.

G. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

H. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

K. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

L. Install steel piping according to applicable plumbing code.

M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

N. Install underground PVC piping according to ASTM D 2321.

O. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Comply with requirements for cleanouts specified in Division 15 Section "Storm Drainage Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by state inspectors.

Q. Install sleeves for piping penetrations of walls, and floors. Comply with requirements for sleeves specified in Division 15 Section "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 15 Section "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls. Comply with requirements for escutcheons specified in Division 15 Section "Escutcheons for Plumbing Piping." Provide 2" border above floor where piping penetrates the concrete mezzanine.

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

E. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Individual, Straight, Horizontal Piping Runs:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

5. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at top, center and base.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3: 60 inches with 1/2-inch rod.
2. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
3. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

G. Install supports for vertical copper tubing every 10 feet.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install wall cleanouts in conductors near floor.
2. Comply with requirements for cleanouts and drains specified in Division 15 Section "Storm Drainage Piping Specialties."

3.7 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Division 15 Section "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify state inspectors at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection, by the state inspector, of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by state inspector to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If state inspector find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed state inspector.

D. Test storm drainage piping according to procedures of state inspector and as noted below:

1. Test for leaks and defects in new piping. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 4 hours before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Aboveground storm drainage piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

B. Underground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Extra Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING 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 storm drainage piping specialties:
   1. Cleanouts.
   2. Roof drains.
   3. Miscellaneous storm drainage piping specialties.
   4. Flashing materials.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Drainage piping specialties shall be made in USA.

1.6 COORDINATION

A. Coordinate size and location of roof penetrations. See architectural roof plan and details for exact locations of roof drains.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts PCO:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Prior approved equal.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.2 ROOF DRAINS

A. Metal Roof Drains: Primary Roof Drain PRD-1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Zurn Z100 or equal by.
    b. Josam Company; Josam Div.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Watts Drainage Products Inc.
    e. Prior approved equal.

2. Standard: ASME A112.21.2M.
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Dimensions of Body: See drawings.
6. Combination Flashing Ring and Gravel Stop: Required.
7. Outlet: Coordinate with drawings.
8. Dome Material: Cast iron.
9. Extension Collars: Required.
10. Underdeck Clamp: Required.
11. Sump Receiver: Required.

B. Secondary Roof Drain SRD-1

1. Same as primary roof drain with a 2” high dam.

2.3 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Nozzle: (secondary drain)

1. All nickel bronze body with decorative face of wall flange and outlet nozzle.
2. Approved Types -

   a. Zurn Z-199 or equal by
   b. Wade
   c. Smith
   d. Josam

2.4 FLASHING MATERIALS

A. See detail on architectural drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground vertical piping risers according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at base of each vertical riser

B. Install roof drains where shown on architectural drawings. Roofing materials are specified in Division 7. See detail on architectural drawing.

1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.

C. Install sleeve flashing device with each riser and stack passing through mezzaine floor with waterproof membrane. Provide 2” dam around opening.

D. Install escutcheons at wall and floor penetrations in exposed finished locations. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. See flashing detail on architectural drawings.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 221513 - AIR ATOMIZATION PIPING

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 piping and related specialties for atomizing air piping operating at 150 psig or less.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Pressure regulators. Include rated capacities and operating characteristics.

B. Brazing certificates.

C. Qualification Data: For Installers.

D. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

B. ASME Compliance:

1. Comply with ASME B31 .1 and ASME B31 .9.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, seamless black with ends threaded according to ASME B1 .20.1.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M. Include ends matching joining method.
2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.

2.2 VALVES

A. Metal Ball and Check Valves: Comply with requirements in Division 15 Section "Valves."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Compressed-Air Distribution Piping: Use the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, black pipe; threaded, malleable-iron fittings; and threaded joints.

3.2 VALVE APPLICATIONS

A. General-Duty Valves: Comply with requirements in Division 15 Section "Valves" for metal general-duty valves. Use metal valves, unless otherwise indicated.

1. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Division 15 Section "Valves" according to the following:

a. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
b. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.

3.3 PIPING INSTALLATION

A. Drawing plans, indicate general location and arrangement of compressed-air piping. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping at right angles and parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

C. Install piping adjacent to equipment and machines to allow service and maintenance.

D. Install air and drain piping with 1 percent slope downward in direction of flow.

E. Install nipples, flanges, unions, transition and special fittings, and valves with pressure

ratings same as or higher than system pressure rating, unless otherwise indicated.

F. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

G. Install piping to permit valve servicing.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 15 Section "Valves."

B. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. NPS 2 and Smaller: Use dielectric unions.

3.7 CONNECTIONS

A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to equipment.

3.8 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping and specialties. Comply with requirements in Division 15 Section "Mechanical Identification."

END OF SECTION 221513

SECTION 223100 - WATER SOFTENERS

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 commercial water softeners as shown and scheduled on the drawings.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Water Softeners. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For water softeners. Include plans, elevations, sections, details, and connections to piping systems.

1. Wiring Diagrams: Power, signal, and control wiring.

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.

C. Manufacturer Certificates: Signed by manufacturers certifying that water softeners comply with requirements.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For water softeners to include in operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

H. Maintenance service agreement.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water softeners and are based on the specific system indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASME Compliance for FRP Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, where indicated.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water softener that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures of mineral and brine tanks.
   b. Faulty operation of controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   d. Attrition loss of resin exceeding 3 percent per year.
   e. Mineral washed out of system during service run or backwashing period.
   f. Effluent turbidity greater and color darker than incoming water.
   g. Fouling of underdrain system, gravel, and resin, with turbidity or by dirt, rust, or scale from softener equipment or soft water, while operating according to manufacturer's written operating instructions.

2. Commercial Water Softener, Warranty Period: From date of Substantial Completion.

   a. Mineral Tanks: 10 years.
   b. Brine Tanks: Five years.
   c. Controls: 10 years.
   d. Underdrain Systems: Five years.

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 COMMERCIAL WATER SOFTENERS

A. Description: Factory-assembled, pressure-type water softener.

1. Manufacturers:

   a. Pacific
   b. CSI Water Treatment Systems; a division of Chandler Systems, Inc.
   c. Culligan International Company.
   d. CUNO Incorporated.
   e. Water King, Inc.
   f. Water Soft, Inc.
   g. Prior approved equal.

2. Comply with NSF 61, "Drinking Water System Components--Health Effects."
3. Configuration: Twin unit with two mineral tanks and one brine tank.
4. Mineral Tanks: FRP, pressure-vessel quality.

   a. Construction: Fabricated and stamped to comply with ASME Boiler and Pressure Vessel Code: Section X, "Fiber-Reinforced Plastic Pressure Vessels."
   b. Pressure Rating: 100 psig minimum.
   c. Wetted Components: Suitable for water temperatures from 40 to at least 100 deg F.
   d. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
   e. Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
   f. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from nonmetallic pipe and fittings with individual, fine-slotted, nonclogging plastic strainers; arranged for even flow distribution through resin bed.
   g. Liner: PE, ABS, or other material suitable for potable water.

5. Controls: Automatic; factory mounted on unit and factory wired.

   a. Adjustable duration of various regeneration steps.
   b. Push-button start and complete manual operation.
   c. Electric time clock and switch for automatic operation, except for manual return to service.
   d. Sequence of Operation: Program multiport pilot-control valve to automatically pressure-actuate main operating valve through steps of regeneration.
   e. Pointer on pilot-control valve shall indicate cycle of operation.
   f. Means of manual operation of pilot-control valve if power fails.

6. Controls: Fully automatic; factory mounted on unit and factory wired.

   a. Adjustable duration of various regeneration steps.
   b. Push-button start and complete manual operation.

c. Electric time clock and switch for fully automatic operation, adjustable to initiate regeneration at any hour of day and any day of week or at fixed intervals.

d. Sequence of Operation: Program multiport pilot-control valve to automatically pressure-actuate main operating valve through steps of regeneration and return to service.

e. Pointer on pilot-control valve shall indicate cycle of operation.

f. Means of manual operation of pilot-control valve if power fails.

g. Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:

1) Slow opening and closing, nonslam operation.
2) Diaphragm guiding on full perimeter from fully open to fully closed.
3) Isolated dissimilar metals within valve.
4) Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
5) Valve for single mineral-tank unit with internal automatic bypass of raw water during regeneration.
6) Sampling cocks for soft water.
7) Special tools are not required for service.

h. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressures, and that does not require field adjustments.

1) Meter Control: Equip each mineral tank with signal-register-head water meter that will produce electrical signal indicating need for regeneration on reaching hand-set total in gallons. Design so signal will continue until reset.
2) Demand-Initiated Control: Equip single mineral-tank units with automatic-reset-head water meter that electrically activates cycle controller to initiate regeneration at preset total in gallons. Design so head automatically resets to preset total in gallons for next service run.
3) Demand-Initiated Control: Equip each mineral tank of twin mineral-tank units with automatic-reset-head water meters that electrically activate cycle controllers to initiate regeneration at preset total in gallons. Design so heads automatically reset to preset total in gallons for next service run. Include electrical lockout to prevent simultaneous regeneration of both tanks.
4) Demand-Initiated Control: Equip each mineral tank of twin mineral-tank units with automatic-reset-head water meter in common outlet header that electrically activates cycle controller to automatically regenerate one mineral tank at preset total in gallons and divert flow to other tank. Set to repeat with other tank. Include electrical lockout to prevent simultaneous regeneration of both tanks.

5) Demand-Initiated Control: Equip each mineral tank of multiple mineral-tank units with automatic-reset-head water meters that electrically activate cycle controllers to automatically regenerate at preset total in gallons. Design so heads automatically reset to preset

total in gallons for next service run. Include electrical lockouts to prevent simultaneous regeneration of more than one tank.

6) Demand-Initiated Control: Equip each mineral tank of multiple mineral-tank units with automatic-reset-head water meter in common outlet header that electrically activates cycle controller to automatically regenerate one mineral tank at preset total in gallons and divert flow to other tanks. Set to repeat with other tanks. Include electrical lockouts to prevent simultaneous regeneration of more than one tank.

7. Brine Tank: Combination measuring and wet-salt storing system.

   a. Tank and Cover Material: Fiberglass, 3/16 inch thick; or molded PE, 3/8 inch thick.
   b. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawn and freshwater refill.
   c. Size: See schedule.

8. Factory-Installed Accessories:

   a. Piping, valves, tubing, and drains.
   b. Sampling cocks.
   c. Main-operating-valve position indicators.
   d. Water meters.

B. Capacity and Characteristics:

1. Service: Cold water for boiler feed make-up.

2. Continuous Service Flow Rate: 43 gpm at 15-psig pressure drop.
3. Peak Service Flow Rate: 58 **gpm at 25-psig** pressure drop.
4. Water Meter Size: 1 1/2”.
5. Manifold Pipe Size: 1 1/2”.
6. Backwash to Drain Pipe Size: 3/4”.
7. Number of Mineral Tanks: Two.
8. Mineral Quantity, Each Tank: 7.0 cu/ft.
9. Mineral Exchange Capacity: 210,000 gr. Ea.
10. Electrical Characteristics:

    a. Volts: 115
    b. Phases: 1
    c. Hertz: 60

11. Salt Capacity: 42” diameter X 60” high.

2.3 CHEMICALS

A. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.

1. Exchange Capacity: of calcium carbonate of resin when regenerated with 15 lb of salt.

B. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are not acceptable.

2.4 WATER TESTING SETS

A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

2.5 SOURCE QUALITY CONTROL

A. Hydrostatically test mineral tanks before shipment to minimum of one and one-half times pressure rating.

B. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER SOFTENER INSTALLATION

A. Install commercial water softener equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor mineral and brine tanks and floor-mounting accessories to substrate.

B. Install seismic restraints for tanks and floor-mounting accessories and anchor to building structure.

C. Install brine lines and fittings furnished by equipment manufacturer but not specified to be factory installed.

D. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.

E. Install water testing sets mounted on wall, unless otherwise indicated, and near water softeners.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between water-softener-unit headers and dissimilar-metal water piping with dielectric fittings. Dielectric fittings are specified in Division 15 Section "Basic Mechanical Materials and Methods."

D. Install shutoff valves where shown on the drawings and isometric.

1. Metal general-duty valves are specified in Division 15 Section "Valves."

E. Install pressure gages on raw-water inlet and soft-water outlet piping of each mineral tank. Pressure gages are specified in Division 15 Section "Meters and Gages."

F. Install valved bypass water piping around water softeners.

1. Metal general-duty valves are specified in Division 15 Section "Valves."
2. Water piping is specified in Division 15 Section "Domestic Water Piping."

G. Install drains as indirect wastes to spill into trench drain.

H. Ground equipment according to Division 16 Section "Grounding and Bonding."

I. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning water softeners that do not pass tests and inspections and retest as specified above.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

B. Add water to brine tank and fill with salt.

C. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:

1. ASTM D 859, "Test Method for Silica in Water."
2. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
3. ASTM D 1068, "Test Methods for Iron in Water."
4. ASTM D 1126, "Test Method for Hardness in Water."
5. ASTM D 1129, "Terminology Relating to Water."
6. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water softeners. Refer to Division 1 Section.

END OF SECTION 223100

SECTION 224000 - PLUMBING FIXTURES

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 conventional plumbing fixtures and related components:

1. Faucets for lavatory and service sinks.
2. Toilet seats.
3. Protective shielding guards.
4. Fixture supports.
5. Water closets.
6. Lavatories.
7. Service basins.

B. Related Sections include the following:

1. Division 15 Section "Emergency Plumbing Fixtures."
2. Division 15 Section "Drinking Fountains and Water Coolers."
3. Division 15 Section "Plumbing Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

E. FRP: Fiberglass-reinforced plastic.

F. PMMA: Polymethyl methacrylate (acrylic) plastic.

G. PVC: Polyvinyl chloride plastic.

H. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Operation and Maintenance Data: For plumbing fixtures to include in operation, and maintenance manuals.

C. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Vitreous-China Fixtures: ASME A1 12. 19.2M.
4. Water-Closet, Flushometer Tank Trim: ASSE 1037.

G. Comply with the following applicable standards and other requirements specified for lavatory and service sink faucets:

1 Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A1 12.18.3M.
2 Faucets: ASME A112.18.1.
3 Hose-Connection Vacuum Breakers: ASSE 1011.
4 Integral, Atmospheric Vacuum Breakers: ASSE 1001.
5 NSF Potable-Water Materials: NSF 61.
6 Pipe Threads: ASME B1.20.1.
7 Supply Fittings: ASME A112.18.1.
8 Brass Waste Fittings: ASME A112.18.2.

H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A1 12.18.1.
3. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Floor Drains: ASME A1 12.6.3.
2. Hose-Coupling Threads: ASME B1.20.7.
3. Off-Floor Fixture Supports: ASME A1 12.6.1M.
4. Pipe Threads: ASME B1.20.1.
5. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: 1 set.
2. Faucet Cartridges and O-Rings: 1 set.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets,:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Moen, Inc.
b. Kohler Co.
c. American Standard Companies, Inc.
d. Chicago Faucets.
e. Delta Faucet Company.
f. Prior approved equal.

2. Description: Two-handle mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 2.0 gpm.
d. Centers: 4 inches.
e. Valve Handle(s): Wrist blade, 4 inches.
f. Inlet(s): NPS 3/8 tubing, with NPS 1/2 male adaptor.
g. Spout: Rigid type.
h. Spout Outlet: Aerator.
i. Operation: Compression, manual.
j. Drain: Grid.
k. Tempering Device: Not required.

2.2 SINK FAUCETS

A. Sink Faucets,:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kohler Co K 8907, vacuum breaker, wall brace, pail hook or equal by.
b. American Standard Companies, Inc.
c. Chicago Faucets.
d. Delta Faucet Company.
e. Moen, Inc.
f. Prior approved equal.

2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass.
b. Finish: Rough brass.
c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
d. Mixing Valve: Two-lever handle.
e. Backflow Protection Device for Hose Outlet: Required.
f. Mounting: wall, exposed.
g. Handle(s): Lever.
h. Spout Type: Rigid, solid brass with wall brace.
i. Spout Outlet: Hose thread.
j. Vacuum Breaker: Required.
k. Operation: Compression, manual.
l. Drain: Grid.

2.3 TOILET SEATS

A. Toilet Seats,:

1. Manufacturers: Subject to compliance with requirements, provide products by

one of the following:
a. Kohler Co.
b. American Standard Companies, Inc.
c. Bemis Manufacturing Company.
d. Church Seats.
e. Olsonite Corp.
f. Prior approved equal.

2. Description: Toilet seat for water-closet-type fixture.

a. Material: Molded, solid plastic.
b. Configuration: Open front cover.
c. Size: Elongated.
d. Hinge Type: CK, check.
e. Class: Standard commercial.
f. Color: White.

2.4 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Engineered Brass Co.
b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
c. McGuire Manufacturing Co., Inc.
d. TCI Products.
e. TRUEBRO, Inc.
f. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
g. Prior approved equal.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.5 FIXTURE SUPPORTS

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. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.

4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.
6. Zurn.
7. Prior approved equal.

2.6 WATER CLOSETS

A. Water Closets, WC-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kohler Co K-3496, Elongated or equal by.
   b. American Standard Companies, Inc.
   c. Eljer.
   d. Prior approved equal.

2. Description: Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for gravity-type tank operation.

   a. Style: Close coupled.

      1) Bowl Type: Elongated with gravity flush design. Include bolt caps matching fixture.
      2) Height: Accessible.
      3) Design Consumption: 1.6 gal./flush.
      4) Tank: Gravity type with trim. Include cover.
      5) Trip Mechanism: Lever-handle actuator.
      6) Color: White.

   b. Supply: NPS 3/8 chrome-plated brass or copper with wheel-handle stop.
   c. Style: Flushometer valve.

2.7 LAVATORIES

A. Lavatories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kohler Co.
   b. American Standard Companies, Inc.
   c. Elijer.
   d. Prior approved equal.

2. Description: Accessible Counter-mounting Undercounter-mounting, self rimming, enameled, cast-iron .

   a. Type: Self-rimming.
   b. Oval Lavatory Size: 20 by 17 inches.
   c. Faucet Hole Punching: Three holes, 4-inch centers.
   d. Faucet Hole Location: Top.
   e. Color: White.

f. Faucet: Lavatory see section faucets.

g. Supplies: NPS 3/8 chrome-plated copper with stops.

h. Drain: Grid with offset waste.

1) Location: Near back of bowl.

i. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated, cast-brass P-trap; NPS 1-1/4, 0.032-inch- thick tubular brass waste to wall; and wall escutcheon.

2.8 SERVICE SINKS

A. Service Sinks, SS-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kohler Co K6652SUDBURY or equal by.
   b. American Standard Companies, Inc.
   c. Eljer.
   d. Prior approved equal.

2. Description: Trap-standard- and wall-mounting, vitreous-china fixture with plain back and stainless steel rim guard on front and sides.
   a. Size: 22 by 20 inches.
   b. Color: White.
   c. Faucet: Sink: See section sink faucets.
   d. Drain: Grid with NPS 3 outlet.
   e. Trap Standard: NPS 3 enameled, cast iron with cleanout and floor flange.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

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

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

C. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

D. Install counter-mounting fixtures in and attached to casework.

E. Install fixtures level and plumb according to roughing-in drawings.

F. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

H. Install actuators in locations that are easy for people with disabilities to reach.

I. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

J. Install toilet seats on water closets.

K. IInstall faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

L. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

M. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."

N. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Eyewash equipment.
2. Water-tempering equipment.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Tepid: Moderately warm.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

B. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

B. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

C. Regulatory Requirements: Comply with requirements in ICC/ANSI A1 17.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.1 EYEWASH EQUIPMENT

A. Standard, Freestanding, Plumbed Eyewash Units:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bradley Corporation Model S19-210 or equal by.
   b. Acorn Safety.
   c. Encon Safety Products.
   d. Guardian Equipment Co.
   e. Haws Corporation.
   f. Prior approved equal.

2. Capacity: Not less than 0.4 gpm for at least 15 minutes.
3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Paddle.
5. Spray-Head Assembly: Two receptor-mounted spray heads.
6. Receptor: 10" diameter stainless-steel or impact resistant Plastic bowl.
7. Drain Piping: NPS 1-1/4 minimum galvanized-steel indirect connection to drainage system.
8. Mounting: Pedestal.

2.2 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water, Water-Tempering Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bradley Corporation model S19-2000 or equal by.
   b. Acorn Safety; a division of Acorn Engineering Company.
   c. Encon Safety Products.
   d. Guardian Equipment Co.
   e. Haws Corporation.
   f. Powers.
   g. Prior approved equal.

2. Description: Factory-fabricated equipment with thermostatic mixing valve.

   a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
   b. Supply Connections: For hot and cold water.

B. Electric Water-Tempering Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Chronomite Laboratories, Inc.; Model E-80 EW.
   b. Prior approved equal.

2. Description: Factory-fabricated equipment with electric heating.

   a. Heating System: Electric, designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, heating coils, high-temperature-limit device, metal piping, and corrosion-resistant enclosure.

      1) Electrical Characteristics: 208-V A, single phase, 60 Hz.

2.3 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball valve. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Division 15 Section "General-Duty Valves for Plumbing Piping."
   1. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Division 15 Section "Domestic Water Piping."

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Division 15 Section "Meters and Gages for Plumbing Piping."

G. Install indirect waste piping on drain outlet of emergency eyewash and route to trench drain. Comply with requirements for waste piping specified in Division 15 Section "Sanitary Waste and Vent Piping."

3.3 CONNECTIONS

A. Connect cold water and electrical power to electric heating water-tempering equipment. Comply with requirements for cold-water piping specified in Division 15 Section "Domestic Water Piping."

B. Indirectly connect emergency eyewash receptors without trapped drain outlet to trench drain.

C. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install eye wash paddle handle with equipment markers. Comply with requirements for identification materials specified in Division 15 Section "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 224500

SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS

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 water coolers and related components:
   1. Pressure water coolers.
   2. Fixture supports.

1.3 DEFINITIONS

A. Accessible Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Fitting: Device that controls flow of water into or out of fixture.

C. Fixture: Water cooler.

D. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

A. Product Data: For water cooler indicated. Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fixture to include in operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filter Cartridges: One.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Water Coolers, EWC-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Elkay Manufacturing Co. **model EHFSA8 or equal by**
   b. Acorn.
   c. Haws Corporation.
   d. Prior approved equal.

2. Description: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler for adult-mounting height.

   a. Cabinet: Single, impact resistant vinyl-covered steel with stainless-steel top.
   b. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
   c. Control: Front and Sides push bars.
   d. Supply: NPS 3/8 with ball valve.

e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.

f. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A1 12.18.1.

g. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.

2) Electrical Characteristics: 370 watts hp; 120-V ac; single phase; 60 Hz.

h. Support: Type I, water cooler carrier. Refer to "Fixture Supports" Article.

2.2 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe.
5. Watts Drainage Products Inc.
6. Zurn .
7. Prior approved equal.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

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

3.2 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install fixtures level and plumb. For fixtures indicated for accessible, install at height required by authorities having jurisdiction.

C. Install water-supply piping with ball valve on supply to water cooler. Use ball valve. Install valve in location where they can be easily reached for operation. Valves are specified in Division 15 Section "Valves."

D. Install trap and waste piping on drain outlet of water cooler and connect to sanitary drainage system.

E. Install pipe escutcheons at wall penetrations if exposed in finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water coolers with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."

D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning water coolers and retest as specified above.
2. Report test results in writing.

3.6 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.7 CLEANING

A. After completing water cooler installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 224700

DIVISION 23
HEATING VENTILATING AND AIR CONDITIONING

230100 GENERAL REQUIREMENTS FOR MECHANICAL
230500 BASIC MATERIALS AND METHODS FOR MECHANICAL
230513 COMMON MOTOR REQUIREMENTS FOR MECHANICAL EQUIPMENT
230519 METERS AND GAGES FOR MECHANICAL PIPING
230523 GENERAL-DUTY VALVES FOR MECHANICAL PIPING
230548 VIBRATION AND SEISMIC CONTROLS FOR MECHANICAL PIPING AND EQUIPMENT
230553 IDENTIFICATION FOR MECHANICAL PIPING AND EQUIPMENT
230593 TESTING, ADJUSTING, AND BALANCING FOR MECHANICAL
230700 MECHANICAL INSULATION
231113 FACILITY FUEL-OIL PIPING
231123 FACILITY NATURAL-GAS PIPING
232113 HYDRONIC PIPING
232213 STEAM AND CONDENSATE HEATING PIPING
232300 REFRIGERANT PIPING
232500 BOILER AND STEAM CHEMICAL TREATMENT
233113 METAL DUCTS
233300 AIR DUCT ACCESSORIES
233713 DIFFUSERS, REGISTERS, AND GRILLES
235100 STACKS
235216 CONDENSING UNITS
235239 FIRE-TUBE BOILERS
235316 DEAERATORS
235400 FURNACES

SECTION 230100 - GENERAL REQUIREMENTS FOR MECHANICAL

PART 1 - GENERAL

1.1 GENERAL

A. General Conditions and Division 01 apply to this Division.

1.2 SCOPE

A. Includes -

1. Furnish all labor, materials, and equipment necessary for the completion of the mechanical and plumbing scope of work associated with installation of a new boiler plant and all associated items, piping, controls the connection of new steam, condensate, water and oil piping into existing.
2. Furnish and install all motors specified in this Division and be responsible for the proper operation of electrical powered equipment furnished by this Division.
3. Furnish exact location of electrical connections and information on motor controls to Division 16.
4. Mechanical Contractor shall obtain the services of independent Test and Balance Agency for the balance of condensate and boiler feed water pumps and furnace system.
5. Placing the new boilers, boiler feedwater, condensate and make-up system and controls into full operation and continuing operation during each working day of testing.
6. The satisfactory performance of the completed systems is a requirement of this specification.

B. Related Work Specified Elsewhere

1. Conduit, line voltage wiring, and disconnect switches specified in Division 16.

1.3 SITE OBSERVATION

A. The Contractor shall examine the existing boiler plant and the proposed site for the new boiler plant and understand the conditions which may affect the performance of work of this Division before submitting proposals for this work.

B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

1.4 DRAWINGS

A. Mechanical drawings show general arrangement of the boilers, deaerator feedwater system, condensate return and transfer system, gas and oil and heating and cooling system, plumbing system, blowdown system, controls system, piping; however, locations are to be regarded as shown diagrammatically only. Follow as closely as actual building construction and work of other trades will permit.

B. Because of the small scale of mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate structural and finished conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

C. If changes in location of piping, equipment, etc. are required due to lack of coordination of work under this division, such changes shall be made without charge. Contractor shall review drawings with USDC and state agencies having jurisdiction and any changes required by them shall be brought to the attention of the Engineer prior to bidding or commencement of work.

D. Contractor shall be responsible for contacting and setting up inspections for the state inspector and state boiler inspector.

1.5 CODE REQUIREMENTS, FEES, AND PERMITS

A. The work shall be installed in accordance with the following applicable codes, ordinances and standards unless otherwise specified. The codes and standards shall include but not be limited to and be of the latest and current editions.

1. American Boiler and Affiliated Industries (AB and AI)
2. American Gas Association (AGA)
3. American National Standards Institute (ANSI)
4. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) - ASHRAE 90.1-2006
5. American Society of Mechanical Engineers (ASME)
6. American Society of Testing Materials (ASTM)
7. American Standards Association (ASA)
8. American Water Works Association (AWWA)
9. American Welding Society (AWS)
10. Associated Air Balance Council (AABC)(NEBB)
11. Heat Exchange Institute (HEI)
12. Hydraulic Institute (HI)
13. National Electrical Code (NEC)
14. National Fire Protection Association (NFPA)
15. Underwriters Laboratories (UL)
16. International Building Code (IBC) 2006 Ed
17. International Mechanical Code (IMC) 2006 Ed
18. International Plumbing Code (IPC) with Utah Amendments 2006 Ed\
19. International Energy Conservation Code (IECC) 2006 Ed

20. Utah State Safety Orders (OSHA/UOSH)
21. Utah Fire Rating Bureau
22. Utah Boiler and Pressure Vessel Law
23. Utah Air Conservation Regulations/Waste Disposal regulations.
24. ASH RAE Ventilation STD .62-2006
25. DFCM and USDC Standards.

B. Should drawings conflict with any code, the code shall govern. If drawings and specifications establish a quality exceeding the code, the drawings and specifications shall govern. If conflicts do exist among the drawings, specifications and codes, the same shall be brought to the attention of the Architect in writing prior to bidding; otherwise Contractor shall comply with applicable codes.

C. The latest edition of all codes shall be used.

1.6 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS

A. Upon completion of work and before final payment, Contractor shall furnish and deliver to the Owner, through the Architect and Engineer, installation, operation and maintenance manuals with instructions for all new materials and equipment used in the building. The contractor shall provide three (3) hard copies of the manuals, and three (3) CD's with electronic copies of the manuals. Electronic information shall be .PDF format. The CD's shall include the same information as the hard copies, and shall be organized in the same manner with electronic bookmarks for each section. CD case and the CD itself shall be labeled the same as the hard copies of the manuals.

B. Bind Operation and Maintenance Manual in a hard-backed piano hinge loose-leaf binder with strong sturdy cover. The project name shall be on the spine and the front of the binder. The front of the binder shall include the following information:

OPERATION
AND
MAINTENANCE
MANUAL
for MECHANICAL SYSTEMS of
(Name of Project)
(Location of Project)
(Date of Project Award)
(Name of Architect)
(Name of Engineer)

C. Introduction

1. Title page including name of project, project number, date awarded and date of substantial completion.
2. Second page shall contain the names, phone numbers and addresses of Architect, Consulting Engineers, and Mechanical Contractor.
3. Third page shall include a Table of Contents for the entire manual.

D. First Section - Summary information including:

1. First page shall contain the contractor's warranties.
2. Second page shall contain a list of names, addresses and phone numbers of contractors and all sub-contractors and work to which each was assigned.
3. Final page or pages shall contain an equipment list of all new equipment, etc. list shall contain equipment numbers, make and model number, Serial No. Identification No. and name, address, and phone number of the supplier.

E. Second Section - Mechanical Equipment O&M data including:

1. Mechanical maintenance schedule, including a lubrication list when necessary.
2. Mechanical Equipment Operation and Maintenance Data including:

   a. Equipment descriptions
   b. Detailed installation instruction, operating and maintenance instructions. Instructions include in a step by step manner identifying start-up, operating, shutdown and emergency action sequence sufficiently clear so a person unfamiliar with the equipment could perform its operations.
   c. Equipment drawings, performance curves, operating characteristics, etc.
   d. Name addresses and phone number of manufacturer, fabricator and local vender clearly printed or stamped on cover.
   e. Complete parts listing which include catalog number, serial number, contract number or other accurate provision for ordering replacement and spare parts.
   f. Certified drawings, where applicable, showing assembly of parts and general dimensions.

3. Approved Mechanical submittals

F. Third Section - Controls O&M data including:

1. Sequence of Operation
2. Description of Boiler control system included location of all control devices. Describe all alarms and cautions for operation.
3. Provide schematic control diagrams, panel diagrams, wiring diagrams, etc. for boilers and all associated systems.

G. Fourth Section - Plumbing Equipment O&M data including:

1. Section shall contain general product catalog cuts, as well as exploded view drawings with parts lists for all valves and other items with multiple parts.
2. Approved Plumbing submittals

H. The Fifth Section shall contain a complete test and balance report. The report shall contain the name, address and phone number of the agency. It shall also include:

1. Test and Balance of condensate transfer system testing of feed water system.
2. Testing of Boiler and Controls.
3. Test and Balance of heating and cooling furnace system.
4. Testing of Boilers - see section 15518.

I. Drawings and reproducible masters of drawings as required in individual specification sections, are not to be bound in volumes but are to be delivered separate with the maintenance manuals.

J. See the following checklist for assistance in assembling manual:

Item #	**Description**	**Y, N, or NA**
1	3 ring heavy duty binder with Project name, number and date on cover and project name on spine.	
2	O&M manual on CD (with label on CD matching label on manual). Electronic copy shall be a PDF file with bookmarks that match the tabs in the hard copy.	
3	Title Page [including project name, number, address, date awarded, date of substantial completion]	
4	Second Page Contact List [including architects, mechanical engineer, consulting engineer, and mechanical contractor]	
5	Table of Contents	
6	**Section 1 - Summary**	
A	Warranty	
B	Mechanical's Sub-contractor List	
C	Vendor List	
D	Equipment List	
7.	**Section 2 – Mechanical Equipment**	
A	Maintenance Schedule (including lubrication list)	
B	Mechanical Equipment O&M Data (for each piece of equipment submitted) per specifications	
C.	Approved mechanical submittals	
8.	**Section 3 - Controls**	
A	Sequence of Operation	
B	Controls diagrams	
9.	**Section 4 – Plumbing Equipment**	
A	Plumbing equipment O&M data	
B	Approved plumbing submittals	
C.	Controls Equipment	
10.	**Section 5 – Test Report**	
A.	Complete Test Report per specifications	

1.7 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Contractor shall instruct building maintenance personnel in the operation and maintenance of the new installed boilers and systems utilizing the Operation and Maintenance Manual when so doing.

B. Minimum instruction periods shall be 8 hours -

1. Four hours in classroom setting.
2. Four hours in boiler room with hands on instructions.

C. Instruction periods shall occur before final site observation when all systems are properly working and before final payment is made.

D. An additional four hours of instruction will be provided by each contractor, after 60 days of system operation by owner to insure proper system operation and answer questions.

1.8 RECORD DRAWINGS

A. Contractor shall keep an up-to-date set of contract drawings in his custody showing all changes in red, clearly defined and neatly drafted by him. At the end of construction, he shall turn these drawings over to the Engineer. Record drawings must be completed and submitted prior to final site observation

.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION 230100

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS FOR MECHANICAL

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. Piping materials and installation instructions common to most piping systems.
2. Mechanical demolition.
3. Equipment installation requirements common to equipment sections.
4. Painting and finishing.
5. Concrete bases.
6. Supports and anchorages.

1.3 SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

B. All materials, piping, etc. shall be new, and domestically made of the best commercial quality obtainable, consistent with specified materials and for the purpose or function intended unless specifically approved in writing prior to bid.

1.5 DELIVERY, STORAGE, AND HANDLING

A. 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.

1.6 COORDINATION

A. Coordinate installation of required supporting devices with existing structural components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE AND FITTINGS

A. Refer to individual Division 15 piping Sections for piping, and fitting materials and joining methods.

B. Pipe Threads: ASME B1 .20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 300 and 250, cast-iron and steel flanges.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

A. Disconnect, demolish, and remove existing water, steam oil and condensate return piping in existing tunnel that will not be reused in new boiler plant.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

B. If pipe or insulation, to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Drawings do not show every offset, or bend that may be required. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping at right angles and parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Verify final equipment locations for roughing-in.

K. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment or boiler connection.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment or boiler connection.

3.5 BOILER, PUMPS AND ECONOMIZER INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of mechanical systems, equipment, and components shall be as specified in
these specifications. See section 15075.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. See structural drawings.
2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base or wall and anchor into structural concrete floor or wall.
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. See structural drawings.

END OF SECTION 230500

SECTION 230513 - MOTOR REQUIREMENTS FOR MECHANICAL 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 basic requirements for factory installed motors for the pumps, burners, etc.

1.3 DEFINITIONS

A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

1.4 SUBMITTALS

A. Provide with equipment.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain field-installed motors through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Compatible with the following:

   a. Magnetic controllers.

2. The burner fan motor shall be capable for future use with variable frequency controllers, and suitable for use throughout speed range without overheating.

3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply to factory installed motors except as follows:

1. Motorized-equipment manufacturer requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

2.2 MOTOR CHARACTERISTICS

A. Motors 1 HP and Larger: Three phase.

B. Frequency Rating: 60 Hz.

C. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

D. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.

E. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 5800 feet above sea level.

F. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

G. Enclosure: Open dripproof for burner fan and totally enclosed for fuel oil pumps.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium, as defined in NEMA MG 1.

C. Stator: Copper windings.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

H. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 230513

SECTION 230519 - METERS AND GAGES FOR MECHANICAL PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Thermowells.
5. Dial-type pressure gages.
6. Gage attachments.

1.3 SUBMITTALS

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

B. Product Certificates: For each type of meter and gage, from manufacturer.

C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Inc.
2. Marsh Bellofram.
3. Miljoco Corporation.
4. Palmer Wahl Instrumentation Group.
5. Trerice, H. O. Co.
6. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
7. Weiss Instruments, Inc.
8. Prior approved equal.

B. Standard: ASME B40.200.

C. Case: sealed type; stainless steel with 3-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type: Union joint, adjustable angle for direct mounting and rigid, with unified-inch screw threads. For panel mounted.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

M. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AMETEK, Inc.; U.S. Gauge.
   b. Ashcroft Inc.
   c. Marsh Bellofram.
   d. Miljoco Corporation.
   e. Palmer Wahl Instrumentation Group.
   f. Trerice, H. O. Co.
   g. Weiss Instruments, Inc.
   h. Prior approved equal.

2. Standard: ASME B40.200.
3. Case: Sealed type, drawn steel; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.
8. Window: Glass.
9. Ring: Stainless steel.
10. Connector Type(s): Union joint, back; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

a. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

N. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Miljoco Corporation.
   b. Palmer Wahl Instrumentation Group.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.
   e. Prior approved equal.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.

   a. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Steel Piping: CRES or CSA.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1 .1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem. Min half way into piping.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ashcroft Inc.
   b. Miljoco Corporation.
   c. Palmer Wahl Instrumentation Group.
   d. Trerice, H. O. Co.
   e. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   f. Weiss Instruments, Inc.
   g. Prior approved equal.

2. Standard: ASME B40.100.
3. Case: Sealed type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ashcroft Inc.
   b. Marsh Bellofram.
   c. Miljoco Corporation.
   d. Palmer Wahl Instrumentation Group.
   e. Trerice, H. O. Co.
   f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   g. Weiss Instruments, Inc.
   h. Prior approved equal.

2. Standard: ASME B40.100.
3. Case: Sealed type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.

8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels for boiler feed water inlet connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length. Mount in finished cabinet and attach the panel to the structural supports.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install valve and snubber in piping for each pressure gage for fluids.

I. Install thermometers in the following locations:

1. Where shown on drawings.

J. Install pressure gages in the following locations:

1. Where shown on drawings.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each fuel-oil pump.
4. Suction and discharge of each pump.

3.2 ADJUSTING

A. Adjust faces of thermometers and gages to proper angle for best visibility. For direct mounted.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping: 0 to 160 deg F.

C. Scale Range for boiler feed water: 0 to 300 deg F.

D. Scale Range for Condensate: 0 to 300 deg F.

E. Scale Range for Stack: 0 to 700 deg F.

F. Scale Range for Steam Piping: 0 to 400 deg F.

3.4 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Oil Piping: -10 to 200 psig.

B. Scale Range for Boiler feed water Piping: 0 to 150 psig.

C. Scale for Condensate Piping: 0 to 150 psig.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR MECHANICAL PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron ball valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Bronze gate valves.
8. Iron gate valves.
9. Iron globe valves.
10. Lubricated plug valves, Natural gas piping only. 11. Chainwheels.

B. Related Sections:

1. Division 15 piping Sections for specialty valves applicable to those Sections only.
2. Division 15 Section "Identification for Piping and Equipment".

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31 .1 for power piping valves.
3. ASME B31 .9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.
3. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for each size square plug-valve head.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Hammond Valve.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Prior approved equal.

2. Description:

   a. Standard: MSS SP-1 10.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Forged brass.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Brass.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

B. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim: Steam Only.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Hammond Valve.
   d. Jamesbury; a subsidiary of Metso Automation.
   e. Kitz Corporation.
   f. Milwaukee Valve Company.
   g. Prior approved equal.

2. Description:

   a. Standard: MSS SP-1 10.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Forged brass.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

C. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   Jomar International, LTD.
   Kitz Corporation.
   Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   Prior approved equal.

2. Description:

   Standard: MSS SP-1 10.
   SWP Rating: 150 psig.
   CWP Rating: 600 psig.
   Body Design: Three piece.
   Body Material: Forged brass.
   Ends: Threaded.
   Seats: PTFE or TFE.
   Stem: Brass.
   Ball: Chrome-plated brass.
   Port: Full.

D. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim: Steam only.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   Jomar International, LTD.
   Kitz Corporation.
   Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   Prior approved equal.

2. Description:

   Standard: MSS SP-1 10.
   SWP Rating: 150 psig.
   CWP Rating: 600 psig.
   Body Design: Three piece.
   Body Material: Forged brass.
   Ends: Threaded.
   Seats: PTFE or TFE.
   Stem: Stainless steel.
   Ball: Stainless steel, vented.
   Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   American Valve, Inc.
   Conbraco Industries, Inc.; Apollo Valves.
   Crane Co.; Crane Valve Group; Crane Valves.
   Hammond Valve.
   Milwaukee Valve Company.
   NIBCO INC.
   g. Prior approved equal.

2. Description:

   Standard: MSS SP-1 10.
   SWP Rating: 150 psig.
   CWP Rating: 600 psig.
   Body Design: Two piece.
   Body Material: Bronze.
   Ends: Threaded.
   Seats: PTFE or TFE.
   Stem: Bronze.
   Ball: Chrome-plated brass.
   Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Steam only.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Conbraco Industries, Inc.; Apollo Valves.
Crane Co.; Crane Valve Group; Crane Valves.
Hammond Valve.
Milwaukee Valve Company.
NIBCO INC.
Prior approved equal.

2. Description:

Standard: MSS SP-1 10.
SWP Rating: 150 psig.
CWP Rating: 600 psig.
Body Design: Two piece.
Body Material: Bronze.
Ends: Threaded.
Seats: PTFE or TFE.
Stem: Stainless steel.
Ball: Stainless steel, vented.
Port: Full.

C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Conbraco Industries, Inc.; Apollo Valves.
DynaQuip Controls.
Hammond Valve.
Milwaukee Valve Company.
NIBCO INC.
Prior approved equal.

2. Description:

Standard: MSS SP-1 10.
SWP Rating: 150 psig.
CWP Rating: 600 psig.
Body Design: Three piece.
Body Material: Bronze.
Ends: Threaded.
Seats: PTFE or TFE.
Stem: Bronze.
Ball: Chrome-plated brass.
Port: Full.

D. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Steam only.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   Conbraco Industries, Inc.; Apollo Valves.
   Hammond Valve.
   Milwaukee Valve Company.
   NIBCO INC.
   e. Prior approved equal.

2. Description:

   Standard: MSS SP-1 10.
   SWP Rating: 150 psig.
   CWP Rating: 600 psig.
   Body Design: Three piece.
   Body Material: Bronze.
   Ends: Threaded.
   Seats: PTFE or TFE.
   Stem: Stainless steel.
   Ball: Stainless steel, vented.
   Port: Full.

2.4 IRON BALL VALVES

A. Class 300, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   American Valve, Inc.
   Conbraco Industries, Inc.; Apollo Valves.
   Kitz Corporation.
   Sure Flow Equipment Inc.
   e. Prior approved equal.

2. Description:

   Standard: MSS SP-72.
   CWP Rating: 200 psig.
   Body Design: Split body.
   Body Material: ASTM A 126, gray iron.
   Ends: Flanged.
   Seats: PTFE or TFE.
   Stem: Stainless steel.
   Ball: Stainless steel.
   i. Port: Full.

2.5 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

American Valve, Inc.
Crane Co.; Crane Valve Group; Crane Valves.
Crane Co.; Crane Valve Group; Jenkins Valves.
Crane Co.; Crane Valve Group; Stockham Division.
Kitz Corporation.
Milwaukee Valve Company.
NIBCO INC.
Prior approved equal.

2. Description:

Standard: MSS SP-80, Type 3.
CWP Rating: 300 psig.
Body Design: Horizontal flow.
Body Material: ASTM B 62, bronze.
Ends: Threaded.
Disc: Bronze.

2.6 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Crane Co.; Crane Valve Group; Crane Valves.
Crane Co.; Crane Valve Group; Jenkins Valves.
Crane Co.; Crane Valve Group; Stockham Division.
Hammond Valve.
Kitz Corporation.
Legend Valve.
Milwaukee Valve Company.
NIBCO INC.
Powell Valves.
Prior approved equal.

2. Description:

Standard: MSS SP-71, Type I.
NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
Body Design: Clear or full waterway.
Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.

Trim: Bronze.
Gasket: Asbestos free.

B. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Crane Co.; Crane Valve Group; Crane Valves.
Crane Co.; Crane Valve Group; Jenkins Valves.
Crane Co.; Crane Valve Group; Stockham Division.
Hammond Valve.
Milwaukee Valve Company.
NIBCO INC.
g. Prior approved equal.

2. Description:

Standard: MSS SP-71, Type I.
NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
Body Design: Clear or full waterway.
Body Material: ASTM A 126, gray iron with bolted bonnet.
Ends: Flanged.
Trim: Bronze.
g. Gasket: Asbestos free.

2.7 BRONZE GATE VALVES

A. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Hammond Valve.
Kitz Corporation.
Milwaukee Valve Company.
NIBCO INC.
Powell Valves.
Prior approved equal.

2. Description:

Standard: MSS SP-80, Type 1.
CWP Rating: 300 psig.
Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
Ends: Threaded.
Stem: Bronze.
Disc: Solid wedge; bronze.
g. Packing: Asbestos free.

h. Handwheel: Malleable iron.

B. Class 150, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Crane Co.; Crane Valve Group; Crane Valves.
Crane Co.; Crane Valve Group; Stockham Division.
Hammond Valve.
Kitz Corporation.
Milwaukee Valve Company.
NIBCO INC.
Powell Valves.
Prior approved equal.

2. Description:

Standard: MSS SP-80, Type 2.
CWP Rating: 300 psig.
Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
Ends: Threaded.
Stem: Bronze.
Disc: Solid wedge; bronze.
Packing: Asbestos free.
Handwheel: Malleable iron.

2.8 IRON GATE VALVES

A. Class 300, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Crane Co.; Crane Valve Group; Crane Valves.
Crane Co.; Crane Valve Group; Stockham Division.
NIBCO INC.
Powell.
e. Prior approved equal.

2. Description:

Standard: MSS SP-70, Type I.
NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
Body Material: ASTM A 126, gray iron with bolted bonnet.
Ends: Flanged.
Trim: Bronze.
Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

B. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Crane Co.; Crane Valve Group; Crane Valves.
Crane Co.; Crane Valve Group; Stockham Division.
Hammond Valve.
Milwaukee Valve Company.
NIBCO INC.
Powell Valves.
g. Prior approved equal.

2. Description:

Standard: MSS SP-70, Type I.
NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
Body Material: ASTM A 126, gray iron with bolted bonnet.
Ends: Flanged.
Trim: Bronze.
Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.9 LUBRICATED PLUG VALVES - NATURAL GAS ONLY:

A. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Nordstrom Valves, Inc.
Prior approved equal.

2. Description:

Standard: MSS SP-78, Type II.
NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
Pattern: Regular.
e. Plug: Cast iron or bronze with sealant groove.

2.10 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Babbitt Steam Specialty Co.
Roto Hammer Industries.

Trumbull Industries.
Prior approved equal.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

Brackets: Type, number, size, and fasteners required to mount actuator on valve.
Attachment: For connection to gate valve stems. Over 96” above floor.
Sprocket Rim with Chain Guides: Cast iron, of type and size required for valve.
Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling. This includes valves supplied by contractor and vavles supplied by equipment manufacturers.

Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage. Make sure all flanged are two-holed with bolt holes at equal distance from top of pipe center line.

Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

Install valves with unions or flanges at each piece of equipment or connections to boiler piping. Arranged to allow service, maintenance, and equipment removal without system shutdown.

Locate valves for easy access and provide separate support where necessary.

Install valves in horizontal piping with stem at or above center of pipe.

Install valves in position to allow full stem movement.

Install chainwheels on operators for gate and globe valves NPS 3 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

Install check valves for proper direction of flow and as follows:

Swing Check Valves: In horizontal position with hinge pin level.
Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

Shutoff Service: Ball, butterfly, or gate valves.
Butterfly Valve Dead-End Service: Single-flange (lug) type.
Throttling Service except Steam: Globe ball or butterfly valves.
Throttling Service, Steam: Globe valves.

5. Pump-Discharge Check Valves:

a. Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

For Steel Piping, NPS 2 and Smaller: Threaded ends.
For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.

3. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 BOILER FEED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

Bronze Valves: threaded ends.
Ball Valves: Two piece, full port, bronze with bronze trim.
Bronze Swing Check Valves: Class 250, bronze disc.
Bronze Gate Valves: Class 250, NRS.

B. Pipe NPS 2-1/2 and Larger:

Iron Valves, NPS 2-1/2 to NPS 4: Flanged ends.
Iron Swing Check Valves: Class 250, metal seats flanged ends.
Iron Gate Valves: Class 250, NRS flanged ends.
Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 250 flanged ends.

3.6 HIGH-PRESSURE STEAM VALVE SCHEDULE MORE THAN 15 PSIG

A. Pipe NPS 2 and Smaller: Threaded.

Ball Valves: Three piece, full port, brass or bronze with brass or bronze trim.
Bronze Swing Check Valves: Class 250, bronze disc.
Bronze Gate Valves: Class 250, RS, bronze.
Globe Valves: Class 250, bronze, disc.

B. Pipe Sizes NPS 2-1/2 and Larger:

Iron Valves, NPS 2-1/2 to NPS 6: Class 300 Iron - Shall be flanged.
Ball Valves, NPS 2-1/2 to NPS 10: Class 300, iron flanged.
High-Performance Butterfly Valves: Class 300, double flange.
Iron Gate Valves: Class 300, NRS flanged.

5. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 300 flanged.

3.7 STEAM-CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

Bronze Angle Valves: Class 300, bronze disc.
Ball Valves: Three piece, full port, brass or bronze with brass or bronze trim.
Bronze Swing Check Valves: Class 300, bronze disc.
Bronze Gate Valves: Class 300, RS.

5. Bronze Globe Valves: Class 300, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

Iron Valves, NPS 2-1/2 to NPS 6: Shall be flanged ends.
Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 300 flanged.
High-Performance Butterfly Valves: Class 300, single flange flanged.
Iron Gate Valves: , NRS flanged.

5. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 300 flanged.

END OF SECTION 230523

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR MECHANICAL PIPING AND 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 the following:

Pipe riser resilient supports.
Seismic snubbers.
3. Restraining braces and cables.

1.3 DEFINITIONS

IBC: International Building Code.

ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

Basic Wind Speed: 100 MPH or Per owner's design standards.
Building Classification Category: As defined in the IBC.
3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

Site Class: As defined in the IBC.
Assigned Seismic Use Group or Building Category: As defined in the IBC.

a. Component Importance Factor: 1.5.

1.5 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Amber/Booth Company, Inc.
Hilti, Inc.
Kinetics Noise Control.
Mason Industries.
Unistrut; Tyco International, Ltd.
Prior approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

Restraint Cables: -steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of

neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

Powder coating on springs and housings.

All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

Baked enamel or powder coat for metal components on isolators for interior use.

Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

Examine areas and equipment to receive seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

Comply with structural drawings for installation of equipment supports, and roof penetrations.

Equipment Restraints:

Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:

Comply with requirements in MSS SP-127.

Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.

3. Brace a change of direction longer than 12 feet.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. 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.

Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

Drilled-in Anchors:

Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION MECHANICAL PIPING AND 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 the following mechanical identification materials and their installation:

Equipment nameplates.
Equipment signs.
3. Pipe markers.

1.3 SUBMITTALS

Product Data: For each type of product indicated.

Samples: For color, letter style, and graphic representation required for each identification material and device.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, and viewing angles of identification devices for piping. Comply with color scheme attached to this section.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Provided and installed by equipment manufacturer. Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

Manufacturer, product name, model number, and serial number.
Capacity, operating and power characteristics, and essential data.

c. Manufacturer equipment date.

Location: Accessible and visible.
Fasteners: As required to mount on equipment.

B. Equipment Signs: Provided and installed by contractor. ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

Data: Equipment, symbol, capacity etc i.e. (BFP-1, gpm @ psi, HP, 208/60/3phase).
Engraving: Manufacturer's standard letter style, 1/4" or larger with terms to match equipment identification.
Thickness: 1/8 inch, unless otherwise indicated.
Fasteners: Self-tapping, stainless-steel screws adhesives not allowed.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

Piping shall be painted throughout to match existing pipe painting.
Colors: Comply with WSU, unless otherwise indicated.
Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

Manufacturer shall provide and install equipment nameplates. Manufacturer shall install
and permanently fasten equipment nameplates on all equipment. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

Equipment signs provided and installed by Contractor shall be attached to equipment with screws (adhesives are not acceptable) on or near each major item of mechanical equipment. Locate signs where accessible and visible.

Identify mechanical equipment with black equipment markers with white lettering.
Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

3. Data: Indicate operational requirements, ie equipment symbol; psi, HP, electrical.

3.3 PIPING IDENTIFICATION

Install manufactured pipe markers indicating service on each piping system. Install
with flow indication arrows showing direction of flow.

Locate pipe markers and color bands where accessible and easily seen:

Near each valve and control device.
Where flow pattern is not obvious.
Near major equipment items and other points of origination and termination.
Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

3.4 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.5 CLEANING

A. Clean faces of mechanical identification devices.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR MECHANICAL

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 TAB to produce design objectives for the following:

1. Hydronic Piping Systems:

   Constant-flow systems.
   Variable-flow systems.
   c. Primary-secondary systems.

2. Verifying that automatic control devices are functioning properly.
3. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

Adjust: To regulate fluid flow.

Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

NC: Noise criteria.

Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

Report Forms: Test data sheets for recording test data in logical order.

Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. TAB: Testing, adjusting, and balancing.

Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

Test: A procedure to determine quantitative performance of systems or equipment.

L. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

Sample Report Forms: Submit two sets of sample TAB report forms.

C. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.

Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep and updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration:

C. Approved TAB agencies:

Bonneville Test and Balance.
BTC Services.
Certified Test and Balance.
Danis Test and Balance.
Intermountain Test and Balance.
RS Analysis.
7. Testing and Balancing, Inc.

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS
(Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

Contract Documents are defined in the General and Supplementary Conditions of Contract.

Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

Examine Project Record Documents described in Division 1 Section "Project Record Documents."

Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

Examine system and equipment installations to verify that they are complete.

Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

Examine strainers for clean screens and proper perforations.

Examine control valves for proper installation and intended function.

Examine new oil pumps and boiler feed pumps and condensate transfer pumps to ensure absence of entrained air in the suction piping.

K. Examine equipment for installation and for properly operating safety interlocks and controls.

L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

Prepare a TAB plan that includes strategies and step-by-step procedures.

Complete system readiness checks and prepare system readiness reports. Verify the following:

Permanent electrical power wiring is complete.

Hydronic systems are filled, clean, and free of air.

3. Boiler feed water control valve is operational.

3.3 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

Prepare test reports for both furnace and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required furnace volume.

Prepare schematic diagrams of systems' "as-built" duct layouts.

Determine the best locations in main and branch ducts for accurate duct airflow measurements.

Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

Verify that motor starters are equipped with properly sized thermal protection.

Check dampers for proper position to achieve desired airflow path.

Check for airflow blockages.

Check condensate drains for proper connections and functioning.

Check for proper sealing of furnace unit components.

Check for proper sealing of air duct system.

3.4 GENERAL PROCEDURES FOR BOILER FEED WATER AND CONDENSATE TRANSFER SYSTEMS

Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

Prepare system for testing and balancing according to the following, in addition to the general preparation procedures specified above:

Open all manual valves for maximum flow.

Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3. Check air vents for a forceful liquid flow exiting from vents when manually operated

3.5 PROCEDURES FOR BOILER FEED WATER AND CONDENSATE TRANSFER SYSTEMS

A. Measure water flow at pumps. Use the following procedures:

Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pumps discharge valve until indicated water flow is achieved.

Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance date. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

3. Report flow rates that are not within plus or minus 5 percent.

B. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

Determine the balancing station with the highest percentage over indicated flow.

Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

C. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures.

3.6 PROCEDURES FOR NEW MOTORS FOR FEED WATER PUMPS, OIL PUMPS AND CONDENSATE TRANSFER PUMPS.

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

Manufacturer, model, and serial numbers.
Motor horsepower rating.
Motor rpm.
Efficiency rating.
Nameplate and measured voltage, each phase.
Nameplate and measured amperage, each phase.

7. Starter thermal-protection-element rating.

3.7 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

Measure entering- and leaving-air temperatures.

Record compressor data.

3.8 PROCEDURES FOR BOILERS

A. Measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

A. Steam Coils: Measure the following data for each unit heater coil:

Dry-bulb temperature of entering and leaving air.
Airflow.
Air pressure drop.
Inlet steam pressure.

B. Refrigerant Coils: Measure the following data for DX coil:

Dry-bulb temperature of entering and leaving air.
Wet-bulb temperature of entering and leaving air.
Airflow.
Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.10 FINAL REPORT

General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:

Pump curves.
Fan curves.
Manufacturers' test data.
Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

Title page.
Name and address of TAB firm.
Project name.
Project location.
Architect's name and address.
Engineer's name and address.
Contractor's name and address.
Report date.
Signature of TAB firm who certifies the report.
Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:

Indicated versus final performance.
Notable characteristics of systems.

c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Test conditions for fans and pump performance forms:

E. Pump Test Reports: Boiler feed water, condensate transfer pumps and oil transfer pumps:

1. Unit Data:

Unit identification.
Location.
Service.
Make and size.
Model and serial numbers.
Water flow rate in gpm.
Water pressure differential in feet of head or psig.
Required net positive suction head in feet of head or psig.
Pump rpm.
Impeller diameter in inches.
Motor make and frame size.
Motor horsepower and rpm.
Voltage at each connection.
Amperage for each phase.
Full-load amperage and service factor.
Seal type.

F. Boiler Test Reports:

1. Unit Data:

Unit identification.
Location.
Service.
Make and type.

Model and serial numbers.
Fuel type and input in Btuh.
Number of passes.
Ignition type.
Burner-control types.
Voltage at each connection.

k. Amperage for each phase.

2. Test Data (Indicated and Actual Values):

Operating pressure in psig.
Operating temperature in deg F.
Entering-water temperature in deg F.
Leaving-water temperature in deg F.
Number of safety valves and sizes in NPS.
Safety valve settings in psig.
High-limit setting in psig.
Operating-control setting.
High-fire set point.
Low-fire set point.
Voltage at each connection.
Amperage for each phase.
Draft fan voltage at each connection.
Draft fan amperage for each phase.

o. Manifold pressure in psig.

G. Furnace Unit Test Reports: For Furnace unit with DX coils, include the following:

1. Unit Data:

Unit identification.
Location.
Make and type.
Model number and unit size.
Manufacturer's serial number.
Discharge arrangement.

g. Number of Filters, type and size.

2. Motor Data:

Make and frame type and size.
Horsepower and rpm.
Volts, phase, and hertz.
Full load amperage and service factor.

3. Test Data (Indicated and Actual Values):

Total airflow rate in cfm.
Total system static pressure in inches wg.
Fan rpm
Discharge static pressure in inches wg.

Filter static-pressure differential in inches wg.
Cooling coil static-pressure differential in inches wg.
Outside airflow in cfm.
Return airflow in cfm.
Outside-air damper position.
Return-air damper position.

H. Apparatus-Coil Test Reports:

1. Coil Data:

System identification
Location.
Coil Type.
Number of rows.
Fin spacing in fins per inch o.c.
Make and model number.
g. Face area in sq. ft.

2. Test Data (indicated and Actual Values):

Airflow rate in cfm.
Average face velocity in fpm.
Air pressure drop in inches wg.
Outside-air, wet-and dry-bulb temperatures in def. F.
Return-air, wet-and dry-bulb temperature in deg. F.
Entering-air, wet-and dry-bulb temperature in deg F.
Leaving-air, wet-and dry-bulb temperature in deg F.
Refrigerant expansion valve and refrigerant types.
Refrigerant suction pressure in psig.
Refrigerant suction temperature in deg F.

I. Fan Test Reports: For exhaust fans, include the following:

1. Fan Data:

System identification.
Location.
Make and type.
Model number and size.
e. Manufacturer's serial number.

2. Motor Data:

Horsepower and rpm.
Volts, phase, and hertz.
c. Full-load amperage and service factor.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.

Total system static pressure in inches wg.
Fan rpm.
Discharge static pressure in inches wg.
Suction static pressure in inches wg.

END OF SECTION 230593

SECTION 230700 - MECHANICAL 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. Section Includes: Insulation of steam, condensate, FGR piping, chemical feed, boiler feed water, water piping (hot and cold), and roof drain piping.

1. Insulation Materials:

   Calcium silicate.
   Mineral fiber.

2. Insulating cements.
   Adhesives.
   Lagging adhesives.
   Factory-applied jackets.
   Field-applied jackets.
   Tapes.
   Securements.
9. Corner angles.

1.3 SUBMITTALS

Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets.

Qualification Data: For qualified Installer.

Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

Store insulation in a protective and dry environment.

1.6 COORDINATION

Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."

Coordinate clearance requirements with piping Installer for piping insulation application.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Calcium Silicate:

1. Products: Subject to compliance with requirements, provide one of the following:

Industrial Insulation Group (The); Thermo-12 Gold.
Prior approved equal.

Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in performing insulation to cover valves, elbows, tees, and flanges. Covers shall be able to withstand 100 psi steam temperature.

D. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

Johns Manville; Micro-Lok.
Owens Corning; Fiberglas Pipe Insulation.
Knauf Insulation; 1000 Pipe Insulation.
Manson Insulation Inc.; Alley-K.
Fibrex Insulations Inc.; Coreplus 1200.
Prior approved equal.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

Insulco, Division of MFS, Inc.; Triple I.
P. K. Insulation Mfg. Co., Inc.; Super-Stik.
c. Prior approved equal.

2.3 ADHESIVES

Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

Childers Products, Division of ITW; CP-97.
Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
Marathon Industries, Inc.; 290.
Mon-Eco Industries, Inc.; 22-30.

Vimasco Corporation; 760.
Prior approved equal.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

Childers Products, Division of ITW; CP-82.
Foster Products Corporation, H. B. Fuller Company; 85-20.
ITW TACC, Division of Illinois Tool Works; S-90/80.
Marathon Industries, Inc.; 225.
Mon-Eco Industries, Inc.; 22-25.
Prior approved equal.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

Childers Products, Division of ITW; CP-52.
Foster Products Corporation, H. B. Fuller Company; 8 1-42.
Marathon Industries, Inc.; 130.
Mon-Eco Industries, Inc.; 11-30.
Vimasco Corporation; 136.
Prior approved equal.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment, and pipe insulation.
Service Temperature Range: Minus 50 to plus 180 deg F.
Color: White.

2.5 FACTORY-APPLIED JACKETS

A. Insulation system shall have factory-applied jackets, factory-applied jackets shall comply with the following:

ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated. Provide jackets on steam piping, condensate piping, boiler feedwater piping,

stacks, vertical drops 8’ - 0” up on rainwater drops and any insulation that could be

damaged.

B. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

Childers Products, Division of ITW; Metal Jacketing Systems.
PABCO Metals Corporation; Surefit.
RPR Products, Inc.; Insul-Mate.
Prior approved equal.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

Sheet and roll stock ready for shop or field sizing.
Finish and thickness are indicated in field-applied jacket schedules.
Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
Factory-Fabricated Fitting Covers:

Same material, finish, and thickness as jacket.
Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
Tee covers.
Flange and union covers.
End caps.
Beveled collars.
Valve covers.
Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
Compac Corp.; 104 and 105.
Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
e. Prior approved equal.

2. Width: 3 inches.
Thickness: 11.5 mils.
Adhesion: 90 ounces force/inch in width.
Elongation: 2 percent.
Tensile Strength: 40 lbf/inch in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
Compac Corp.; 110 and 111.
Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

e. Prior approved equal.

2. Width: 3 inches.
Thickness: 6.5 mils.
Adhesion: 90 ounces force/inch in width.
Elongation: 2 percent.
Tensile Strength: 40 lbf/inch in width.

7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
Compac Corp.; 120.
Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
Venture Tape; 3520 CW.

e. Prior approved equal.

2. Width: 2 inches.
Thickness: 3.7 mils.
Adhesion: 100 ounces force/inch in width.
Elongation: 5 percent.
Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

Childers Products; Bands.
PABCO Metals Corporation; Bands.
RPR Products, Inc.; Bands.
Prior approved equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide.

3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide.

2.9 CORNER ANGLES

PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface. Calcium silicate insulation shall be under PVC corner covering.

Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

Verify that systems and equipment to be insulated have been tested and are free of defects.
Verify that surfaces to be insulated are clean and dry.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Mix insulating cements with clean potable water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of stack, piping including fittings, valves, and specialties.

Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of stacks and pipe system as specified in insulation system schedules.

Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

Install insulation with longitudinal seams at top when looking up and bottom when looking down of horizontal runs.

Install multiple layers of insulation with longitudinal and end seams staggered.

Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

Keep insulation materials dry during application and finishing.

Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

Install insulation with least number of joints practical.

Where vapor barrier is indicated, seal joints, seams, and any penetrations in insulation with vapor-barrier mastic.

1. Install insulation continuously through hangers i.e. hangers on outside of insulation and around anchor attachments.

Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

Draw jacket tight and smooth.

Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. Do not install insulation to the following:

Vibration-control devices.
Testing agency labels and stamps.
Nameplates and data plates.
Handholes.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Terminate insulation before roof penetrations.

1. For applications requiring only indoor insulation, terminate insulation below roof surface and seal with joint sealant.

3.5 GENERAL PIPE INSULATION INSTALLATION

Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.

Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

Label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

Install removable insulation covers at locations indicated. Installation shall conform to the following:

Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.6 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Boiler Stack:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.

Install 2-layer insulation with joints tightly butted and staggered at least 3 inches.

Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals. Finish with a metal jacket.
Minimum insulation thickness 4 inches.

B. Insulation Installation on Straight Pipes and Tubes:

Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

C. Insulation Installation on Pipe Flanges:

Install preformed pipe insulation to outer diameter of pipe flange.
Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
Finish flange insulation same as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.

3. Finish fittings insulation same as pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:

Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
Install insulation to flanges as specified for flange insulation application.

3. Finish valve and specialty insulation same as pipe insulation.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

B. Insulation Installation on Pipe Flanges:

Install preformed pipe insulation to outer diameter of pipe flange.

Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

Install preformed sections of same material as straight segments of pipe insulation when available.

When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

Install preformed sections of same material as straight segments of pipe insulation when available.

When preformed sections are not available, install mitered sections of pipe insulation to valve body.

Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

1. Where metal jackets are indicated, install per manufacturers recommendations,

3.9 EQUIPMENT INSULATION SCHEDULE

Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

Boiler Breeching:

1. Calcium Silicate: 4 inches thick.

Deaerator Tank:

1. Calcium Silicate: 3 inches thick.

Condensate Tank

1. Calcium Silicate: 3 inch thick.

E. Provide Metal Jacket.

3.10 PIPING INSULATION SCHEDULE, GENERAL

Acceptable preformed pipe insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

Drainage piping and intermitten blowdown piping.
Fuel oil piping.
Natural Gas Piping.
Steam traps and trap piping.

C. Piping System insulation:

Boiler Feed Water Piping - Mineral Fiber or calcium silicate, per chart.
Domestic Water Piping -Mineral Fiber, per chart.
Chemical feed piping - Mineral Fiber, 1”.
Continuous blowdown piping - mineral fiber 2 1/2”.
Steam piping - mineral fiber/calcium silicate: per chart.
Condensate Piping - Mineral Fiber/Calcium Silicate: Per chart.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Minimum Pipe Insulation Thickness from ANSI/ASHRAE/IESNA Standard 90.1-2004

Fluid Design Operating Temp. Range (°F	**Insulation Conductivity**		**Nominal**				
	Conductivity Btu.in./(h.ft2.°F)	**Mean Rating Temp. °F**	**<1**	**1 to <1-1/2**	**1-1/2 to <4**	**4 to <8**	**?8**
Heating Systems (Steam, Steam Condensate, and Hot Water)							
>350	0.32-0.34	250	2.5	3.0	3.0	4.0	4.0
251-350	0.29-0.32	200	1.5	2.5	3.0	3.0	3.0
201-250	0.27-0.30	150	1.5	1.5	2.0	2.0	2.0
141-200	0.25-0.29	125	1.0	1.0	1.0	1.5	1.5

105-140	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Domestic and Service Hot Water Systems							
105+	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Cooling Systems (Chilled Water, Brine, and Refrigerant)							
40-60	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
<40	0.22-0.28	100	0.5	1.0	1.0	1.0	1.5

3.12 INDOOR, FIELD-APPLIED METAL JACKET SCHEDULE

Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

Piping, Exposed:

END OF SECTION 230700

SECTION 231113 - FACILITY FUEL-OIL PIPING

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 #2 fuel-oil distribution systems and the following:

Pipes, tubes, and fittings.
Piping and tubing joining materials.
Piping specialties.
Valves.
Fuel-oil UST accessories.
Fuel-oil storage tank piping specialties.
Fuel-oil storage tank pumps.
Liquid-level gage system.
Leak-detection and monitoring system.
Mechanical sleeve seals.
11. Grout.

B. The underground steel storage tank is existing. This contractor shall provide new manhole and cover for access to a new tank mounted oil transfer pump.

C. Since the existing oil storage tank is underground this contractor along with specifications shall design build the new manhole, sump, cover , leak detector system, tank level monitoring system and the new tank submersible, turbine pump.

1.3 DEFINITIONS

Exposed, Interior Installations: Exposed to view indoors. Examples include boiler room.

FPM: Vinyl idene fluoride-hexafluoropropylene copolymer rubber.

FRP: Glass-fiber-reinforced plastic.

UST: Underground storage tank.

1.4 PERFORMANCE REQUIREMENTS

A. Maximum Operating-Pressure Ratings: 150-psig fuel-oil supply pressure at oil-fired burner.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include, material descriptions, and dimensions of individual components and profiles. Also include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

Piping specialties.
Valves: Include pressure rating, capacity, settings, and electrical connection data of selected models.
Fuel-oil storage tank accessories.
Fuel-oil storage tank piping specialties.
Fuel-oil storage tank pump
Liquid-level gage system.
7. Leak-detection and monitoring system.

B. Welding certificates.

Field quality-control reports.

Operation and Maintenance Data: For fuel-oil equipment and accessories to include in operation, and maintenance manuals.

E. Warranty: Sample of warranty.

1.6 QUALITY ASSURANCE

Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Comply with ASME B31 .9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.

Comply with requirements of the EPA and of state and local authorities having jurisdiction.

E. All piping, etc shall be made in USA.

1.7 DELIVERY, STORAGE, AND HANDLING

Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

Store pipes and tubes with protective PE coating to avoid damaging the coating and to protect from direct sunlight.

C. Store PE pipes and valves protected from direct sunlight.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Fuel-Oil Service: Do not interrupt fuel-oil service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fuel-oil supply according to requirements indicated:

Notify Owner no fewer than 72 hours in advance of proposed interruption of fuel-oil service.
Do not proceed with interruption of fuel-oil service without Owner's written permission.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of double-containment piping, oil pump and related equipment that fail in materials or workmanship within specified warranty period.

1. Flexible, Double-Containment Piping and Related Equipment:

Failures due to defective materials or workmanship for materials installed together, including piping.
Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

See Part 3 piping schedule articles for where pipes, tubes, fittings, and joining materials are applied in various services.

Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, seamless for all interior piping including tunnel piping.

Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
Wrought-Steel Welding Fittings: ASTM A 234/A 234M, for butt and socket welding.

Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

Material Group: 1.1.
End Connections: Threaded or butt welding to match pipe.
Lapped Face: Not permitted underground.
Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.

e. Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.

2.2 DOUBLE-CONTAINMENT PIPE AND FITTINGS

A. Rigid, Double-Containment Piping: Comply with UL 971.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Ameron International; Fiberglass Pipe Group.
Conley Corporation.
Perma-Pipe, Inc.
Smith Fibercast.

e. Prior approved equal.

2. RTRP: ASTM D 2996 or ASTM D 2997 carrier and containment piping and mechanical couplings to seal carrier and containment piping or individually bonded joints.

Minimum Operating-Pressure Rating for RTRP NPS 2: 150 psig.
Fittings: RTRF complying with ASTM D 2996 or ASTM D 2997, and made by RTRP manufacturer; watertight manway entry penetrations, termination, or other end fittings.

3. Include design and fabrication of double-containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.

2.3 PIPING SPECIALTIES

1. Nonmetallic Connectors:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

American Flexible Hose Co., Inc.
Flexicraft Industries.
3) FLEX-ING, Inc.

Hose Master, Inc.
Metraflex Company.
Tru-Flex Metal Hose Corp.
Prior approved equal.

Listed and labeled for underground applications by an NRTL acceptable to authorities having jurisdiction.
PFTE bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.
Minimum Operating Pressure: 150 psig.
End Connections: Socket, flanged, or threaded end to match connected piping.
Maximum Length: 30 inches.
Swivel end, 50-psig maximum operating pressure.

h. Factory-furnished anode.

B. Y-Pattern Strainers:

Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
End Connections: Threaded ends for NPS 2 and smaller.
Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
CWP Rating: 150 psig.

C. Basket Strainers: Dual with manual switch - over.

Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
End Connections: Threaded ends for NPS 2 and smaller.
Strainer Screen: 60-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
CWP Rating: 150 psig.

D. Manual Air Vents:

Body: Bronze.
Internal Parts: Nonferrous.
Operator: Screwdriver or thumbscrew.
Inlet Connection: NPS 1/2.
Discharge Connection: NPS 1/8.
CWP Rating: 150 psig.

7. Maximum Operating Temperature: 225 deg F.

2.4 JOINING MATERIALS

Joint Compound and Tape: Suitable for fuel oil.

Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

2.5 MANUAL FUEL-OIL SHUTOFF VALVES

See valve schedule in Part 3 for where each valve type is applied in various services.

General Requirements for Metallic Valves, NPS 2 and Smaller for Liquid Service: Comply with UL 842.

CWP Rating: 150 psig.
Threaded Ends: Comply with ASME B1.20.1.
Tamperproof Feature: Locking feature for valves indicated in the valve schedule.
Service Mark: Initials "WOG" shall be permanently marked on valve body.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-1 10.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   Kitz
   BrassCraft Manufacturing Company; a Masco company.
   Conbraco Industries, Inc.; Apollo Div.
   Prior approved equal.

2. Body: Bronze, complying with ASTM B 584.
   Ball: Chrome-plated bronze.
   Stem: Bronze; blowout proof.
   Seats: Reinforced TFE; blowout proof.
   Packing: Threaded-body packnut design with adjustable-stem packing.
   Ends: Threaded, flared, or socket as indicated in the valve schedule.
   CWP Rating: 600 psig.
9. Service Mark: Initials "WOG" shall be permanently marked on valve body.

2.6 SPECIALTY VALVES

A. Pressure Relief Valves: Comply with UL 842.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   Anderson Greenwood; Division of Tyco Flow Control.
   Fulflo Specialties, Inc.
   Webster Fuel Pumps & Valves; a division of Capital City Tool, Inc.
   Prior approved equal.

2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
3. Body: Brass, bronze, or cast steel.

Springs: Stainless steel, interchangeable.
Seat and Seal: Nitrile rubber.
Orifice: Stainless steel, interchangeable.
Factory-Applied Finish: Baked enamel.

B. Mechanical Leak Detector: Comply with UL 842.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

FE Petro, Inc.
Red Jacket Pumps; a division of Veeder-Root.
c. Prior approved equal.

2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
Body: ASTM A 126, cast iron.
O-Rings: Elastomeric compatible with fuel oil.
Piston and Stem Seals: PTFE.
Stem and Spring: Stainless steel.
Piston Cylinder: Burnished brass.
Indicated Leak Rate: Maximum 3 gph at 10 psig.
9. Leak Indication: Reduced flow.

2.7 FUEL-OIL UST ACCESSORIES

Tank Manholes: 30-inch- minimum diameter; bolted, flanged, and gasketed, with extension collar; for access to existing fuel oil supply line on existing tank.

Containment Sumps: [**Fiberglass]** [**PE]** with sump base, add-on extension pieces as required, sump top, lid, and gasket-seal joints. Include sump entry boots for pipe penetrations through sidewalls.

C. Sump Entry Boots: Two-part pipe fitting for field assembly and of size required to fit over pipe. Include gaskets shaped to fit sump sidewall, sleeves, seals, and clamps as required for liquid-tight pipe penetrations.

2.8 SUBMERSIBLE FUEL-OIL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

FE Petro, Inc.
Red Jacket Pumps; a division of Veeder-Root.
3. Prior approved equal.

B. Description: Comply with UL 79, UL 87, and UL 343.

Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
Impeller: Turbine.
Housing and Volute: Cast iron.
Bearings: Bronze, self-lubricating.
Seals: Mechanical.
Shaft: Polished steel.
Suspension Piping: Telescoping to accommodate existing tank diameter and depth of bury.
Base: Steel.
Pressure Relief: Built in.
Discharge Check Valve: Built in.

11. Drive: Direct, close coupled.

C. Controls: Pump controller panel complying with UL 353 and UL 508C and with interlock and terminals for connections to fuel-oil-burning equipment.

Run pump to maintain minimum manifold pressure with outdoor-air temperature less than 60 deg F.
Alarm motor failure.
Manual reset dry-run protection. Stop pumps if fuel level falls below pump suction.
Deenergize and alarm pump locked rotor condition.
Alarm open circuit, high and low voltage.
Indicating lights for power on, run, and off normal conditions.

7. Interface with automatic control system to control and indicate the following:

Start/stop pump when required by boilers operation.
Operating status.

c. Alarm off-normal status.

D. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Motors."

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
Thermal-Overload Protection: Motor-winding temperature sensor.

3. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 16 Sections.

E. Capacities and Characteristics: See schedule on drawings.

2.9 COMBINATION LEAK-DETECTION AND TANK LEVEL MONITORING SYSTEM

A. Cable and Sensor system: Comply with UL 1238.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

OPW.
Veeder-Root

Containment Solutions
In-Situ, Inc.
MSA, Insrutment Div.
Raychem Corp.

Calibrated, leak-detection and monitoring system with probes and other sensors and remote alarm panels for existing steel fuel-oil storage tank and new fuel-oil piping.
Include fittings and devices required for testing.
Controls: Electrical, operating on 120-V ac.
Calibrated, liquid-level gage complying with UL 1238 with probes.
Remote Annunciator Panel: With visual and audible, high-tank-level and low-tank-level alarms, fuel indicator with registration in gallons, and overfill alarm. Include gage volume range that covers fuel-oil storage capacity.
Controls: Electrical, operating on 120-V ac.

2.10 FUEL OIL

A. Fuel Oil: ASTM D 396, Grade No. 2.

2.11 SLEEVES

Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

2.12 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   Link seal or equal by.
   Pipeline Seal and Insulator, Inc.
   Advance Products & Systems, Inc.
   Calpico Inc.
   Metraflex Company (The).
   Prior approved equal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure links to sealing elements. Include one nut and bolt for each sealing element.

PART 3 - EXECUTION

3.1 EXAMINATION

Examine roughing-in for fuel-oil piping system to verify actual locations of piping connections before equipment installation.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Comply with requirements in Division 2 Section "Earthwork" for excavating, trenching, and backfilling. See civil utility drawings.

3.3 PREPARATION

Close equipment shutoff valves before turning off fuel oil to premises or piping section.

Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.4 OUTDOOR PIPING INSTALLATION

Install underground fuel-oil piping buried at least 24 inches or as shown below finished grade. Comply with requirements in Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

RTRP rigid double wall piping:

Apply joint cover kits to pipe after joining, to cover, seal, and protect joints.
Replace piping damaged.

Install double-containment, fuel-oil pipe at a minimum slope of 1 percent downward toward new fuel-oil storage tank sump.

Assemble and install entry boots for pipe penetrations through new sump sidewalls for liquid-tight joints.

Install metal pipes and tubes, fittings, valves, and flexible connectors at piping connections to AST and UST.

Install fittings for changes in direction in rigid pipe.

Install system components with pressure rating equal to or greater than system operating pressure.

Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for

1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

Mechanical Sleeve Seal Installation: Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Install pressure gage on discharge from new submersible pump. Pressure gages are specified in Division 15 Section "Meters and Gages."

K. Install pressure gages on upstream and downstream of basket strainers and discharge of burner supplied pump.

3.5 INDOOR PIPING INSTALLATION

Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

Arrange for pipe spaces and openings in building structure during progress of construction, to allow for mechanical installations.

Install piping at right angles and parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

Install piping free of sags and bends.

Install fittings for changes in direction and branch connections.

Verify final equipment locations for roughing-in.

Prohibited Locations:

1. Do not install fuel-oil piping in solid walls or partitions.

Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

Connect branch piping from top of horizontal piping.

Install unions in pipes NPS 2 and smaller at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.

Do not use fuel-oil piping as grounding electrode.

Install dual basket strainer on inlet side of fuel-oil pump.

3.6 VALVE INSTALLATION

Install manual fuel-oil shutoff valves on branch connections to fuel-oil appliance.

Install valves in accessible locations.

Protect valves from physical damage.

Identify valves as specified in Division 15 Section "Mechanical Identification."

Install pressure relief valves in distribution piping between the supply and return lines.

Install one-piece, bronze ball valve with hose end connection at low points in fuel-oil piping.

G. Install manual air vents at high points in fuel-oil piping.

3.7 PIPING JOINT CONSTRUCTION

Ream ends of pipes and tubes and remove burrs.

Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.

Bevel plain ends of steel pipe.

Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

Flanged Joints: Install gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

Fiberglass-Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.8 HANGER AND SUPPORT INSTALLATION

A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

NPS 1-1/4 and Smaller: Maximum span, 84 inches; minimum rod size, 3/8 inch.
NPS 1-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.

B. Support vertical steel pipe at spacing not greater than 15 feet.

3.9 FUEL-OIL PUMP INSTALLATION

Submersible Pumps:

1. Suspend pumps from supply piping and anchored to bottom of tank.

Transfer Pumps:

1. Install pumps per burner manufacture if shipped loose with access space for periodic maintenance including removal of motors, impellers, and accessories.

Install two-piece, full-port ball valves at suction and discharge of pumps.

Install mechanical leak-detector valves at pump discharge.

Install dual basket strainer on inlet side of simplex fuel-oil pumps.

Install check valve on discharge of simplex fuel-oil pumps.

Install suction piping with minimum fittings and change of direction.

Install vacuum and pressure gage, upstream and downstream respectively, at each pump to measure the differential pressure across the pump. Pressure gages are specified in Division 15 Section "Meters and Gages."

3.10 COMBINATION LEAK-DETECTION AND LEVEL GAGE MONITORING SYSTEM INSTALLATION

A. Install leak-detection and level gage monitoring system. Install alarm panel inside building where indicated or per owners instructions.

Double-Containment, Fuel-Oil Piping: Install leak-detection sensor probes in fuel-oil storage tank containment sump and at low points in piping.
Install liquid-level gage.

3.11 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final

connection to each piece of equipment having threaded pipe connection.

Connect piping to equipment with ball valve and union. Install union between valve and equipment.

3.12 LABELING AND IDENTIFYING

A. Nameplates, pipe identification, and signs are specified in Division 15 Section "Mechanical Identification."

3.13 FIELD PAINTING OF ABOVEGROUND PIPING

Comply with requirements in Division 9 painting Sections for painting interior fuel-oil piping.

Paint interior metal piping, valves, and piping specialties, except components with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

   Prime Coat: Alkyd anticorrosive metal primer.
   Intermediate Coat: Interior latex matching topcoat.
   Topcoat: Interior latex low sheen.
   Color: Match campus standard.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.14 FIELD QUALITY CONTROL

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Piping: Minimum hydrostatic or pneumatic test-pressures measured at highest point in system:

   Fuel-Oil Distribution Piping: 100 psig for minimum 2 hours minutes.
   Fuel-Oil, Double-Containment Piping:

Carrier Pipe: 75 psig for minimum 2 hours.
Containment Conduit: Minimum 50 psig for minimum 60 minutes.

c. Isolate storage tanks if test pressure in piping will cause pressure in storage tanks to exceed 10 psig.

Inspect and test fuel-oil piping according to NFPA 31, "Tests of Piping" Paragraph; and according to requirements of authorities having jurisdiction.
Test liquid-level gage for accuracy by manually measuring fuel-oil levels at not less than three different depths while filling tank and checking against gage indication.
Test leak-detection and monitoring system for accuracy by manually operating sensors and checking against alarm panel indication.
Start fuel-oil transfer pumps to verify for proper operation of pump and check for leaks.
Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
Bleed air from fuel-oil piping using manual air vents.

Fuel-oil piping and equipment will be considered defective if it does not pass tests and inspections.

Prepare test and inspection reports.

3.15 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain liquid-level gage systems leak-detection and monitoring systems and fuel-oil pumps.

3.16 OUTDOOR PIPING SCHEDULE

Underground fuel-oil piping shall be[**one of]** the following. Size indicated is carrier-pipe size.

1. Rigid, double-containment piping.

Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.17 INDOOR PIPING SCHEDULE

A. Aboveground fuel-oil piping shall be the following:

NPS 1/2 and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.
NPS 5/8 to NPS 2: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.

3.18 ABOVEGROUND MANUAL FUEL-OIL SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe NPS 2 and smaller shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 15192

SECTION 231123 - FACILITY NATURAL-GAS PIPING

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

Section Includes: Providing new gas to 5'-0" outside new boiler plant.

Extend interior gas piping to serve boilers and furnace.

Pipes, tubes, and fittings.
Piping specialties.
Piping and tubing joining materials.
Valves.
5. Pressure regulators.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 125 psig minimum unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of the following:

Piping specialties.
Valves. Include pressure rating, capacity, and settings data of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.

B. Welding certificates.

Field quality-control reports.

Operation and Maintenance Data: For pressure regulators to include in operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

Pipe Welding Qualifications: Qualify procedures and operators according to ASME

Boiler and Pressure Vessel Code.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

Notify Owner no fewer than 72 hours in advance of proposed interruption of natural-gas service.
Do not proceed with interruption of natural-gas service without Owner's permission and coordination.

1.8 COORDINATION

A. Coordinate shut/down of existing natural gas with owner and operators of the heating plant.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Seamless.

Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

Material Group: 1.1.
End Connections: Threaded or butt welding to match pipe.

Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
Bolts and Nuts: ASME B18.2.1, carbon steel.

2.2 JOINING MATERIALS

Joint Compound and Tape: Suitable for natural gas.

Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MANUAL GAS SHUTOFF VALVES

See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services. See specifications “Valves”.

General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

CWP Rating: 125 psig.
Threaded Ends: Comply with ASME B1.20.1.
Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.

5. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

CWP Rating: 125 psig.
Flanged Ends: Comply with ASME B16.5 for steel flanges.
Tamperproof Feature; Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide one of the following:

BrassCraft Manufacturing Company; a Masco company.
Conbraco Industries, Inc.; Apollo Div.
McDonald, A. Y. Mfg. Co.
Perfection Corporation; a subsidiary of American Meter Company.

e. Prior approved equal..

2. Body: Bronze, complying with ASTM B 584.

Ball: Chrome-plated brass.
Stem: Bronze; blowout proof.
Seats: Reinforced TFE; blowout proof.
Packing: Separate packnut with adjustable-stem packing threaded ends.
Ends: Threaded, flanged, or socket as indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
CWP Rating: 600 psig.
Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.4 PRESSURE REGULATORS

A. General Requirements:

Single stage and suitable for natural gas.
Steel jacket and corrosion-resistant components.
Elevation compensator.
End Connections: Flanged.

B. Pressure Regulators: Comply with ANSI Z21 .80.

1. Manufacturers: Subject to compliance with requirements, provide one of the following:

Fisher Control Valves and Regulators; Division of Emerson Process Management.
American Meter Company.
Actaris.
Invensys.
Richards Industries; Jordan Valve Div.
Prior approved equal..

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
Springs: Zinc-plated steel; interchangeable.
Diaphragm Plate: Zinc-plated steel.
Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
Orifice: Aluminum; interchangeable.
Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
Overpressure Protection Device: Factory mounted on pressure regulator.

11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

PART 3 - EXECUTION

3.1 EXAMINATION

Examine routing for natural-gas piping system to verify actual locations of piping connections before installation.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Coordinate with heat plant supervisor and work with them in turning off natural gas to premises or piping section.

Inspect new and existing natural-gas piping according to the International Fuel Gas Code.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

Drawing plans and isometrics indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

Install piping at right angles and parallel to building walls. Diagonal runs are prohibited

Locate valves for easy access.

Install piping free of sags and bends.

Install fittings for changes in direction and branch connections.

Verify final boiler and gas train locations for roughing-in.

Drips and Sediment Traps: Install drips at points where condensate may collect. Locate where accessible to permit cleaning and emptying.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

I. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level

side down.

Connect branch piping from top or side of horizontal piping.

Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to boiler connections. Unions are not required at flanged connections.

Do not use natural-gas piping as grounding electrode.

Install strainer on inlet of each line-pressure regulator.

Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 15 Section "Meters and Gages."

P. Coordinate gas and pilot trains provided by boiler manufacturer for installation by contractor. Provide all vent piping etc.

3.4 VALVE INSTALLATION

A. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.5 PIPING JOINT CONSTRUCTION

Ream ends of pipes and tubes and remove burrs.

Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: 2” and less.

Thread pipe with tapered pipe threads complying with ASME B1.20.1.
Cut threads full and clean using sharp dies.
Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.

5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints: 2 1/2” and larger.

Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
Bevel plain ends of steel pipe.

3.6 HANGER AND SUPPORT INSTALLATION

Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

Comply with requirements for pipe hangers and supports specified in Division 15 Section "Hangers and Supports."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

3.7 CONNECTIONS

Install piping adjacent to appliances to allow service and maintenance of appliances.

Connect piping to boiler gas and pilot trains.

C. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip.

3.8 LABELING AND IDENTIFYING

A. Comply with requirements in Division 15 Section "Mechanical Identification" for piping and valve identification.

3.9 PAINTING

Comply with requirements in Division 9 painting Sections for painting new interior natural-gas piping to match color scheme.

Paint metal piping, valves, regulators, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

Prime Coat: Quick-drying alkyd metal primer.
Intermediate Coat: Interior latex matching topcoat.
Topcoat: Interior latex (semigloss).
Color: match existing.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

Perform tests and inspections.

Tests and Inspections:

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

Natural-gas piping will be considered defective if it does not pass tests and inspections.

Prepare test and inspection reports.

3.11 PIPING SCHEDULE

Aboveground, branch piping 1 1/2” and smaller shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

Aboveground, distribution piping 2” and larger shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

Valves for pipe sizes NPS 2 and smaller shall be the following:

1. One-piece, bronze ball valve with bronze trim.

Valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

Two-piece, full-port, bronze ball valves with bronze trim.
Cast-iron, nonlubricated plug valve.

END OF SECTION 15195

SECTION 232113 - HYDRONIC PIPING

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 pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

Boiler feedwater piping.
Condensate-drain piping.
Blowdown piping.
Air-vent piping.
5. Safety-valve-inlet and -outlet piping.

1.3 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

Boiler Feedwater Piping: 150 psig at 240° F.
Condensate-Drain Piping: 225° F.
Blowdown Piping: 350° F.
Air-Vent Piping: Equal to the pressure of the piping system to which it is attached.
5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.4 SUBMITTALS

Welding certificates.

Qualification Data: For Installer.

Field quality-control test reports.

Operation and Maintenance Data: Specialties, and special-duty valves to include in operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 250 as indicated in Part 3 "Piping Applications" Article.

Malleable-Iron Unions: ASME B16.39; Classes 150, and 250, as indicated in Part 3 "Piping Applications" Article.

Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 150 and 300; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

Material Group: 1.1.

End Connections: Butt welding.

3. Facings: Raised face.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, maximum thickness unless thickness or specific material is indicated.

Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
Narrow-Face Type: For raised-face, Class 300, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.3 VALVES

Gate, Globe, Check and Ball, Valves: Comply with requirements specified in Division 15 Section "Valves."

Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 15 Section "HVAC Instrumentation and Controls."

2.4 CHEMICAL TREATMENT

A. Chemical treatment for the steam boilers and deaerator system is noted elsewhere.

2.5 PIPING SPECIALTIES

A. Y-Pattern Strainers:

Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
CWP Rating: 300 psig.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

Boiler feedwater piping, aboveground, 2 inch and smaller, shall be the following:

1. Schedule 80 steel pipe; Class 250, cast-iron fittings; and threaded joints.

Boiler feedwater piping, aboveground, 2-1/2 inch shall be the following:

1. Schedule 80 steel pipe, class 250 wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

Condensate-Drain Piping: Schedule 40 steel pipe class 250 cast iron fittings.

Steam Blowdown Piping: Schedule 80 steel pipe class 300 cast iron fitting.

E. Safety-Valve-Inlet and -Outlet Piping for Steam Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed inlet piping shall be ASME code piping.

3.2 VALVE APPLICATIONS

Install valves as shown on the drawings. Coordinate valves provided by others and installed by contractor with those provided and installed by contractor.

Install check valves at each pump discharge and elsewhere as required to control flow direction.

C. Install safety valves provided by boiler manufacturer at new boiler and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.3 PIPING INSTALLATIONS

Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

Install piping at right angles and parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

Install piping to permit valve servicing.

Install piping at indicated slopes.

Install piping free of sags and bends.

Install fittings for changes in direction and branch connections.

Install piping to allow application of insulation.

Select system components with pressure rating equal to or greater than system operating pressure.

Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

Install drains, consisting of a tee fitting, ball valve, and short threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

Reduce pipe sizes using eccentric reducer fitting installed with level side up.

Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

Install valves according to Division 15 Section "Valves."

Install unions in piping, 2” and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

Install flanges in piping, 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

Install strainers on inlet side of each control valve, oil pumps, and elsewhere as indicated.

Q. Identify piping as specified in Division 15 Section "Mechanical Identification."

3.4 HANGERS AND SUPPORTS

Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports." Comply with the following requirements for maximum spacing of supports.

Seismic restraints are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.

Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.

E. Support vertical runs to roof, at roof penetration.

3.5 PIPE JOINT CONSTRUCTION

Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.

Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, and elsewhere as required for system air venting.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for piping connections shall be the same as or larger than equipment connections.

Install control valves in accessible locations close to connected equipment.

Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

3.8 CHEMICAL TREATMENT

Fill the new piping with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

See treatment section.

3.9 FIELD QUALITY CONTROL

A. Prepare piping according to ASME B31 .9 and as follows:

Leave joints, including welds, uninsulated and exposed for examination during test.
Flush piping systems with clean water; then remove and clean or replace strainer screens.
Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on piping:

Use ambient temperature water as a testing medium.
While filling system, use vents installed at high points of system to release air.
Use drains installed at low points for complete draining of test liquid.
Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31 .9, "Building Services Piping."
After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.

5. Prepare written report of testing.

END OF SECTION 232113

SECTION 232223 - STEAM AND CONDENSATE PIPING

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 for HP and up steam and condensate piping:

Pipe and fittings.
Strainers.
Safety valves.
Steam traps.
Thermostatic air vents and vacuum breakers.
Steam meters.

1.3 DEFINITIONS

HP Systems: High-pressure piping operating at more than 15 psig as required by ASME B31.1.

MP Systems: Medium pressure piping operating at 15 psig and less.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

HP Steam Piping: 300 psig

MP Steam Piping: 125 psig.
Condensate Piping: 100 psig at 250 deg F.
Makeup-Water Piping: 80 psig at 150 deg F.
Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.

7. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

Steam trap.
Air vent and vacuum breaker.
3. Meter steam.

B. Qualification Data: For Installer.

Welding certificates.

Field quality-control test reports.

E. Operation and Maintenance Data: For valves, safety valves, steam traps, air vents, vacuum breakers, and meters to include in operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code - Steel."

Pipe Welding: Qualify processes and operators according to the following:

Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.1, "Power Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.

Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in Part 3 piping applications articles.

Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 piping applications articles.

Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 300 as indicated in Part 3 piping applications articles; raised ground face, and bolt holes spot faced.

Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

Material Group: 1.1.
End Connections: Butt welding.
3. Facings: Raised face.

G. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

2.2 JOINING MATERIALS

Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

   a. Narrow-Face Type: For raised-face, Class 300, cast-iron and steel flanges.

Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

2.3 VALVES

Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 15 Section "Valves."

Stop-Check Valves: Provided by boiler manufacturer, installed by contractor.

2.4 STRAINERS

A. Y-Pattern Strainers:

Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
Tapped blowoff plug.

5. CWP Rating: 300-psig working steam pressure.

2.5 SAFETY VALVES

A. Safety Valves: Provided by Boiler manufacturer installed by contractor.

2.6 STEAM TRAPS

A. Float and Thermostatic Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   Armstrong International, Inc.
   Barnes & Jones, Inc.
   Dunham-Bush, Inc.
   Hoffman Specialty; Division of ITT Industries.
   Spirax Sarco, Inc.
   Sterling.
   g. Prior approved equal.

2. Body and Bolted Cap: ASTM A 126, cast iron.
   End Connections: Threaded.
   Float Mechanism: Replaceable, stainless steel.
   Head and Seat: Hardened stainless steel.
   Trap Type: Balanced pressure.
   Thermostatic Bellows: Stainless steel or monel.
   Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.
   Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless steel cage, valve, and seat.
   Maximum Operating Pressure: 125 psig.

B. Inverted Bucket Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   Armstrong International, Inc.
   Barnes & Jones, Inc.
   Dunham-Bush, Inc.
   Hoffman Specialty; Division of ITT Industries.
   Spirax Sarco, Inc.
   Sterling.
   g. Prior approved equal.

2. Body and Cap: Cast iron.
   End Connections: Threaded.
   Head and Seat: Stainless steel.

Valve Retainer, Lever, and Guide Pin Assembly: Stainless steel.
Bucket: Brass or stainless steel.
Strainer: Integral stainless-steel inlet strainer within the trap body.
Air Vent: Stainless-steel thermostatic vent.

9. Pressure Rating: 250 psig.

2.7 STEAM METERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Provide only if not provided by boiler manufacturer.

EMCO Flow Systems; Division of Advanced Energy Company.
ISTEC Corp.
Preso Meters; a division of Racine Federated Inc.
Spirax Sarco, Inc.

5. Prior approved equal.

B. Meters shall have a microprocessor to display totalizer flow, flow rate, temperature, pressure, time, and date; alarms for high and low flow rate and temperature.

Computer shall have 4 to 20-mA or 2 to 10 volt output for temperature, pressure, and contact closure for flow increments.
Independent timers to store four peak flow rates and total flow.
Interface compatible with future workstation.
Microprocessor Enclosure: NEMA 250, Type 4.

C. Sensor: Vortex type with stainless-steel wetted parts and wafer or flange connections; and with a piezoelectric sensor removable and serviceable without shutting down the process. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.

PART 3 - EXECUTION

3.1 HP and MP STEAM PIPING APPLICATIONS

HP and MP Steam Piping, NPS 2 and Smaller: Schedule 80, seamless steel pipe; Class 125 cast-iron fittings; and threaded joints.

HP and MP Steam Piping, NPS 2-1/2 through NPS 12: Schedule 80, semaless steel pipe; Class 300 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

Condensate piping above grade, NPS 2 and smaller, shall be the following:

1. Schedule 80, Seamless steel pipe; Class 250 cast-iron fittings; and threaded joints.

Condensate piping above grade, NPS 2-1/2 and larger, shall be the following:

1. Schedule 80, Seamless steel pipe; Class 250 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.2 ANCILLARY PIPING APPLICATIONS

Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.3 VALVE APPLICATIONS

Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the inlet and outlet of steam traps.

Install safety valves on new boiler as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, through the roof as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.4 PIPING INSTALLATION

Drawing plans indicate general location and arrangement of new piping systems. Use indicated piping locations and arrangements if such were used to size pipe and calculate expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

Install piping at right angles and parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

Install piping to permit valve servicing.

Install piping free of sags and bends.

Install fittings for changes in direction and branch connections.

Install piping to allow application of insulation.

Select system components with pressure rating equal to or greater than system operating pressure.

Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

I. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

Install steam supply piping at a minimum uniform grade of 0.2 percent downward in

direction of steam flow.

Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.

Reduce pipe sizes using eccentric reducer fitting installed with level side down.

Install branch connections to mains with the branch connected to top of main pipe.

Install valves according to Division 15 Section "Valves."

Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

Install strainers on supply side of traps, and elsewhere as indicated. Locate steam strainers on side.

Install expansion loops, and anchor as shown.

Identify piping as specified in Division 15 Section "Mechanical Identification."

T. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.

3.5 STEAM-TRAP INSTALLATION

Install steam traps in accessible locations as close as possible to connected equipment.

Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

3.6 STEAM METER INSTALLATION

Install meters with lengths of straight pipe upstream and downstream according to steam meter manufacturer's instructions.

Provide data acquisition wiring.

3.7 SAFETY VALVE INSTALLATION

Install safety valves according to ASME B31 .1, "Power Piping."

Pipe safety-valve discharge without valves to atmosphere outside the building as shown and detailed on the drawings.

C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.

3.8 HANGERS AND SUPPORTS

Install hangers and supports according to Division 15 Section "Hangers and Supports." Comply with requirements below for maximum spacing.

Seismic restraints are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.

Install hangers with the following maximum spacing and minimum rod sizes:

NPS 3/4: Maximum span, 9 feet; minimum rod size, 1/4 inch.
NPS 1: Maximum span, 9 feet; minimum rod size, 1/4 inch.
NPS 1-1/2: Maximum span, 12 feet; minimum rod size, 3/8 inch.
NPS 2: Maximum span, 13 feet; minimum rod size, 3/8 inch.
NPS 2-1/2: Maximum span, 14 feet; minimum rod size, 3/8 inch.
NPS 3: Maximum span, 15 feet; minimum rod size, 3/8 inch.
NPS 4: Maximum span, 17 feet; minimum rod size, 1/2 inch.
NPS 6: Maximum span, 21 feet; minimum rod size, 1/2 inch.
9. NPS 12: Maximum span, 30 feet; minimum rod size, 7/8 inch.

E. Support vertical runs at roof, penetration.

3.9 PIPE JOINT CONSTRUCTION

Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

Ream ends of pipes and remove burrs. Bevel plain ends.

Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.10 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than equipment connections.

3.11 FIELD QUALITY CONTROL

A. Prepare steam and condensate piping according to ASME B31.9, "Building Services Piping," and as follows:

Leave joints, including welds, uninsulated and exposed for examination during test.
Flush system with clean water. Clean strainers.

B. Perform the following tests on steam and condensate piping:

Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.

3. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

C. Prepare written report of testing.

END OF SECTION 15182

SECTION 232300 - REFRIGERANT PIPING

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 refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-134a:

Suction Lines for Air-Conditioning Applications: 115 psig.
Liquid Lines: 225 psig.

B. Line Test Pressure for Refrigerant R-410A:

Suction Lines for Air-Conditioning Applications: 300 psig.
Liquid Lines: 535 psig.

1.4 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

Thermostatic expansion valves.
Filter dryers.
Strainers.
Pressure-regulating valves.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

Comply with ASME B31 .5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.7 COORDINATION

A. Coordinate size and location of equipment supports, and will penetrations.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

Copper Tube: ASTM B 88, Type L or ASTM B 280, Type ACR.

Wrought-Copper Fittings: ASME B 16.22.

Wrought-Copper Unions: ASME B16.22.

Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

Brazing Filler Metals: AWS A5.8.

Flexible Connectors:

Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
End Connections: Socket ends.
Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
Pressure Rating: Factory test at minimum 500 psig.

5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

A. Thermostatic Expansion Valves: Comply with ARI 750.

Body, Bonnet, and Seal Cap: Forged brass or steel.
Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
Packing and Gaskets: Non-asbestos.
Capillary and Bulb: Copper tubing filled with refrigerant charge.
Suction Temperature: 40 deg F.
Superheat: Adjustable.
End Connections: Socket, flare, or threaded union.
Working Pressure Rating: 700 psig.

B. Permanent Filter Dryers: Comply with ARI 730.

Body and Cover: Painted-steel shell.
Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
Desiccant Media: Activated alumina.
End Connections: Socket.
Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
Maximum Pressure Loss: 2 psig.
Rated Flow: 2 Tons.
Working Pressure Rating: 500 psig.

9. Maximum Operating Temperature: 240 deg F.

2.3 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Atofina Chemicals, Inc.
DuPont Company; Fluorochemicals Div.
Honeywell, Inc.; Genetron Refrigerants.
INEOS Fluor Americas LLC.

5. Prior approved equal.

B. ASHRAE 34, R-134a: Tetrafluoroethane.

C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-134a

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.3 VALVE AND SPECIALTY APPLICATIONS

Install diaphragm packless valves in suction and discharge lines of compressor part of condenser package.

Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection part of condenser package.

C. Install thermostatic expansion valves as close as possible to distributors on

evaporators.

Install valve so diaphragm case is warmer than bulb.
Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line or in the vertical.

3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

D. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

Install filter dryers in liquid line between compressor and thermostatic expansion valve.

Install receivers sized to accommodate pump-down charge.

G. Install flexible connectors at compressors.

3.4 PIPING INSTALLATION

Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

Install refrigerant piping according to ASHRAE 15.

Install piping at right angles and parallel to building walls. Diagonal runs are prohibited.

Install piping adjacent to machines to allow service and maintenance.

Install piping free of sags and bends.

Install fittings for changes in direction and branch connections.

Select system components with pressure rating equal to or greater than system operating pressure.

Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.

Slope refrigerant piping as follows:

Install horizontal suction lines with a uniform slope downward to compressor.
Install traps and double risers to entrain oil in vertical runs.

3. Liquid lines may be installed level.

When brazing or soldering, remove sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Install pipe sleeves at penetrations in exterior walls and floor assemblies.

Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Install sleeves through floors and walls sized to permit installation of full-thickness insulation.

Seal pipe penetrations through exterior walls according to Division 7 Section "Joint Sealants" for materials and methods.

Identify refrigerant piping and valves according to Division 15 Section "Mechanical Identification."

3.5 PIPE JOINT CONSTRUCTION

Ream ends of tubes and remove burrs.

Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.6 HANGERS AND SUPPORTS

Hanger, support, and anchor products are specified in Division 15 Section "Hangers and Supports" and are shown on the drawings.

Install the following pipe attachments:

Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.

3.7 FIELD QUALITY CONTROL

Perform tests and inspections and prepare test reports.

Tests and Inspections:

Comply with ASME B31 .5, Chapter VI.
Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

Fill system with nitrogen to the required test pressure.
System shall maintain test pressure at the manifold gage throughout duration of test.
Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.8 SYSTEM CHARGING

A. Charge system using the following procedures:

Install core in filter dryers after leak test but before evacuation.
Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
Charge system with a new filter-dryer core in charging line.

3.9 ADJUSTING

Adjust thermostatic expansion valve to obtain proper evaporator superheat.

Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

Adjust set-point temperature of air-conditioning to the system design temperature.

Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

Verify that compressor oil level is correct.

Open compressor suction and discharge valves.
Open refrigerant valves except bypass valves that are used for other purposes.
Check open compressor-motor alignment and verify lubrication for motors and bearings.

END OF SECTION 15183

SECTION 232500 - BOILER AND STEAM CHEMICAL TREATMENT

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 treatment systems:

Boiler System.
Steam and Condensate System.
Oxygen Scavenger System.
Boiler Blowdown.
Chemical treatment test equipment.
Chemical Station with pumps.

1.3 DEFINITIONS

EEPROM: Electrically erasable, programmable read-only memory.

Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

TDS: Total dissolved solids.

UV: Ultraviolet.

1.4 PERFORMANCE REQUIREMENTS

Chemical Treatment of Boiler systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of equipment without creating a hazard to operating personnel or the environment.

Base chemical treatment on quality of water available at Project site, system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Steam Boiler and Steam Condensate:

1. Steam Condensate:

a. pH: Maintain a value within 7.8 to 8.4.

Total Alkalinity: Maintain a value within 5 to 50 ppm.

Chemical Oxygen Demand: Maintain a maximum value of 15 ppm.
Soluble Copper: Maintain a maximum value of 0.20 ppm.
TDS: Maintain a maximum value of 10 ppm.
Ammonia: Maintain a maximum value of 20 ppm.
Total Hardness: Maintain a maximum value of 2 ppm.

2. Steam boiler shall have the following water qualities:

"OH" Alkalinity: 200 to 400 ppm.
TDS: Maintain a value within 600 to 1200 ppm.

1.5 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

Water meters.
Chemical Feed Station (stand)
3. Inhibitor injection timers.
pH controllers.
TDS controllers.
Biocide feeder timers.
Chemical solution tanks.
Injection pumps.
Chemical test equipment.
10. Chemical material safety data sheets.

B. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in operation, and maintenance manuals.

C. Other Informational Submittals:

Chemical-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve the quality defined in the "Performance Requirements" Article above.

Water Analysis: Illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

Chemical -Treatment Service Provider Qualifications: Powers is the USDC treatment contractor and will continue for this project. No other treatment Co. is approved.

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Powers.
Prior approved equal.

2.2 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Water Meter: Softwater make-up to surge tank.

AWWA C701, turbine-type, totalization meter.
Body: Bronze.
Minimum Working-Pressure Rating: 100 psig.
Maximum Pressure Loss at Design Flow: 3 psig.
Registration: Gallons.
End Connections: Threaded.

7. Control: Low-voltage signal capable of transmitting 1000 feet.

B. Meter: Boiler Feedwater piping to each boiler.

Onicon model 1130SS316 W/10gal/per/pulse sealed output.
Minimum Working-Pressure Rating: 150 psig.
Maximum Pressure Loss at Design Flow: 3 psig.
Registration: Gallons.

5. End Connections: Flanged.

C. Chemical Solution Tanks:

Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
Capacity: As required by Powers.

D. Chemical Solution Injection Pumps:

Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
Adjustable flow rate.
Metal and thermoplastic construction.
Built-in relief valve.

5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 15 Section "Motors."

Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.

Injection Assembly:

Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
Ball Valve: Three-piece, stainless steel as described in "Stainless-Steel Pipes and Fittings" Article below; and selected to fit quill.
Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

2.3 STAINLESS-STEEL PIPES AND FITTINGS

Stainless-Steel Tubing: Comply with ASTM A 269, Type 316.

Stainless-Steel Fittings: Complying with ASTM A 815/A 815M, Type 316, Grade WP-S.

Two-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, carbon-filled TFE seats, threaded body design with adjustable stem packing, threaded ends, and 250-psig SWP and 600-psig CWP ratings.

Three-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, threaded body design with adjustable stem packing, threaded ends, and 150-psig SWP and 600-psig CWP rating.

2.4 CHEMICAL TREATMENT TEST EQUIPMENT

Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers.

Sample Cooler:

1. Tube: Sample.

   Size: NPS 1/4 tubing.
   Material: ASTM A 666, Type 316 stainless steel.
   Pressure Rating: Minimum 2000 psig.
   Temperature Rating: Minimum 850 deg F.

2. Shell: Cooling water.

   Material: ASTM A 666, Type 304 stainless steel.
   Pressure Rating: Minimum 250 psig.
   c. Temperature Rating: Minimum 450 deg F.

2.5 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain quality specified in Part 1 "Performance Requirements" Article.

2.6 STEAM AND BOILER TREATMENT SYSTEM.

The boiler internal treatment shall consist of a polymeric dispersant, sequestrering agent and ortho Phosphate.

The boiler internal treatment shall be fed to the boiler feedwater line from a solution mixing tank with agitator.

Solution mixing tank shall be a PECO model 50 checmial mix tank complete with 1/4 hp agitator, hinged tank cover, suction assembly, strainer and relief valve.
Chemical solution pump shall be a Neptune Model 515-A-N1, capable of delivering 3 GPH @ 250 psig.

3. Chemical solutions shall be made down with boiler feedwater or soft water.

C. The steam condensate treatment shall be fed to the boiler feedwater line from a solution mixing tank with agitator.

Solution mixing tank shall be a PECO model 50 chemical mix tank complete with 1/4 hp agitato, hinged tank cover, suction assembly, strainer and relief valve.
Chemical solution pump shall be a Neptune Model 515-A-N1, capable of delivering 3 GPH @ 250 psi.

3. Chemical solutions shall be made down with boiler feedwater or soft water.

D. Metering pumps for boiler internal treatment and steam condensate treatment shall be activated based on metered feedwater flow.

Provide a high temperature meter installed in the boiler feedwater line to each boiler. Meter shall be compatible with the boiler feedwater temperature, pressure, chemical ingredients and PH.
Feedwater meters shall be Onicon Model 1130 SS316 w/ 10 gal per pulse sealed output.

E. Oxygen scavenger treatment will consist of sodium sulfite powder or Liquid.

Boiler oxygen scavenger treatment shall be fed to the surge tank CT-1 from a solution mixing tank with agitator.
Solution mixing tank shall be a PECO model 60 chemical mix tank complete with 1/4 hp agitator, hinged tank cover, suction assembly, strainer and relief valve.
Chemical or solution pump shall be a Neptune Model 515-A-N1, capable of delivering 3 GPH @ 250 psig.
Chemical solutions shall be made down with boiler feedwater or soft water.

5. Boiler oxygen scavenger treatment pump shall be activated based on metered make up flow.

Provide a pulse output meter with totalizing register installed in the make up water line to the Surge Tank.

1. Meter shall be Seametrics Type MJR sized to match make up water line.

Steam/condensate system chemical treatment will consist of a neutralizing amine to provide for neutralization of all portions of the system. System pH shall be maintained at:

Condensate pH: 7.8.

Maximum concentration: 10 ppm amine in steam.

3. Steam condensate treatment will be a single amine or blend of amines.

H. Boiler blowdown control:

One (1) conductivity controller will be provided for all three boilers.

The Conductivity/blowdown controller shall incorporate the latest in solid state/microprocessor technology.

Controller shall include serial communications.

Controller shall include digital display and shall be programmed through a local keypad or by connection to a remote computer.

Controller Enclosure shall be rated NEMA 4X.

Controller software shall include five (5) weeks of data logging storage capacity. Data logging parameters shall include all measured sensors. Controller software shall include alarm callout capabilities.

I. Equipment:

One (1) EController CEC8-364B microprocessor based conductivity and blowdown controller w/ (3) Motorized blowdown valve assemblies, complete with:

Three (3) conductivity sensors with 3/4” sensor cross.

Three (3) 1/2” DEI High temp motorized ball valves w/spring assist closed actuators,

Three (3) 1/2” Parker high temp metering valves

Serial communications, data logging and modem,

Four (4) 4-20 milli-amp isolated outputs on conductivity from each boiler,

7. One (1) external wiring terminal box with 120 VAC motor start coils to accommodate three (3) LMI A141-257 chemical feed pumps and three (3) 1/4HP mixers. Motor start coils to receive 120 VAC power from a separate power circuit than that powering the EController CEC8 controller. Note that the base controller must be provided to accommodate one (1) future boiler.

J. An ultrasonic level sensor shall be mounted in each of the treatment feed tanks. The level sensors shall be continuous monitioring and shall send level signal to be connected to the EController blowdown control. The blowdown control shall be configured to monitor treatment tank levels sand to deactivate the treatment metering pumps upon low level.

K. Provide Three (3) boiler high temperature feedwater meters sized for installation in each individual boiler feedwater line.

Meters shall be Onicon Model 1130 SS316 with sealed output of 1 dry contact per 10 gallons of flow.
Each meter will be mounted through a 1” stainless steel ported ball valve to be provided with the meter.

L. Provide one (I) water make up meter, for installation in the make up line to the surge tank,

Provide Neptune Model CS-75-316 corporation stops with quills for chemical injection into the feedwater lines, surge tank.

Provide one (1) Madden sample cooler with 316SS coil for each boiler.

Sample cooler shall be piped to the surface blowdown line of each boiler as shown in the equipment details.
Cooling water supplied to the sample cooler shall come from the water softeners.

O. Control: Testing equipment shall be provided to include a Hach Model 890 spectrophotometer.

Provide burettes and reagents for determining Phenolpthalein and Methyl Purple Alkalinity, Total Hardness, Sodium Sulfite, orthophosphate and total iron.
Additionally, provide one (1) Myron L Model 532-M1conductivity meter.

3. Provide one (1) PECO L1215 Test Cabinet to accommodate 3 titrations with associated glassware.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

Install chemical application equipment on concrete floor, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

Install water testing equipment on wall near water chemical application equipment.

Install interconnecting control wiring for chemical treatment controls and sensors.

Mount sensors and injectors in piping circuits.

E. Install automatic chemical-feed equipment for steam boiler and steam condensate systems and include the following:

Install water meters in makeup water suppies.
Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.

a. Pumps shall operate for timed interval when contacts close at water meter in makeup water supply connection. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.

Install test equipment and furnish test-kit to Owner.
Install TDS controller with sensor and bleed valves.

a. Bleed valves shall cycle to maintain maximum TDS concentration.

5. Install inhibitor injection timer with injection pumps and solution tanks.

a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection. Injection pump shall discharge into main steam supply header.

3.3 CONNECTIONS

Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

Install piping adjacent to equipment to allow service and maintenance.

Make piping connections between chemical-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 15 Section "Basic Mechanical Materials and Methods."

Install shutoff valves on chemical-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 15 Section "Valves."

Confirm applicable electrical requirements in Division 16 Sections for connecting electrical equipment.

Ground equipment according to Division 16 Section "Grounding and Bonding."

G. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a Power's factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

Inspect field-assembled components and equipment installation, including piping and electrical connections.
Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals to systems.
Place chemical-treatment system into operation and calibrate controls during the preliminary phase of systems' startup procedures.
Do not put piping into operation until it is tested and satisfactory test results are achieved.
Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.

7. Repair leaks and defects with new materials and retest piping until no leaks exist.

C. Remove and replace malfunctioning units and retest as specified above.

Sample boiler feed water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Sample boiler feed water at four-week intervals following the testing noted above to show that the automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.

Comply with ASTM D 3370 and with the following standards:

Steam System: ASTM D 1066.
Acidity and Alkalinity: ASTM D 1067.
Iron: ASTM D 1068.
Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

A. Engage a Power's factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chemical-treatment systems and equipment. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 232500

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

Single-wall rectangular ducts and fittings.
Single-wall round ducts and fittings.
Sheet metal materials.
Duct liner.
Sealants and gaskets.
Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:

Division 15 Section "Duct Accessories" for dampers, turning vanes, and flexible ducts.
Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. Static-Pressure Classes:

Supply Ducts: 2-inch wg.
Return Ducts (Negative Pressure): 1-inch wg.
c. Exhaust Ducts (Negative Pressure): 1-inch wg.

2. Leakage Class:

Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.
c. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

Seismic Hazard Level A: Seismic force to weight ratio, 0.48.

Seismic Hazard Level B: Seismic force to weight ratio, 0.30.

3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

Liners and adhesives.

Sealants and gaskets.

3. Seismic-restraint devices.

B. Welding certificates.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, Provide products by one of the manufacturers specified.

Lindab Inc.
McGill AirFlow LLC.
SEMCO Incorporated.
Sheet Metal Connectors, Inc.
Spiral Manufacturing Co., Inc.
Metco.

g. Prior approved equal.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

Galvanized Coating Designation: G60.
Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

CertainTeed Corporation; Insulation Group.
Johns Manville.
Knauf Insulation.
Owens Corning.
Prior approved equal.
Maximum Thermal Conductivity:

Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

Duct insulation shall have a minimum R value = 5 for installation in an unconditioned space.

B. Insulation Pins and Washers:

Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

Adhere a single layer of indicated thickness of duct liner with at least 90 percent

adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

Butt transverse joints without gaps, and coat joint with adhesive.

Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

a. Fan discharges.

2.5 SEALANT AND GASKETS

General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

Water-Based Joint and Seam Sealant:

Application Method: Brush on.

Solids Content: Minimum 65 percent.

Shore A Hardness: Minimum 20.

Water resistant.

Mold and mildew resistant.

VOC: Maximum 75 g/L (less water).

Maximum Static-Pressure Class: 10-inch wg, positive and negative.

Service: Indoor or outdoor.

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

General: Single-component, acid-curing, silicone, elastomeric.

Type: S.

Grade: NS.

Class: 25.

5. Use: O.

Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

Round Duct Joint O-Ring Seals:

Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.7 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Cooper B-Line, Inc.; a division of Cooper Industries.
Ductmate Industries, Inc.
Hilti Corp.
Kinetics Noise Control.
Mason Industries.
Unistrut Corporation; Tyco International, Ltd.

7. Prior approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of

cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

Install round ducts in maximum practical lengths.

Install ducts with fewest possible joints.

Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 SEAM AND JOINT SEALING

A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C, except as follows:

    a. Ducts that are located directly in zones they serve.

3.3 HANGER AND SUPPORT INSTALLATION

Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

Where practical, install concrete inserts before placing concrete.
Install powder-actuated concrete fasteners after concrete is placed and completely cured.
Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

Hangers Exposed to View: Threaded rod and angle or channel supports.

Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 SEISMIC-RESTRAINT-DEVICE INSTALLATION

Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Brace a change of direction longer than 12 feet.

Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

Install cables so they do not bend across edges of equipment or building structure.

Install cable restraints on ducts that are suspended with vibration isolators.

Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.5 CONNECTIONS

Make connections to equipment with flexible connectors complying with Division 15 Section "Duct Accessories."

Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

Perform tests and inspections.

Leakage Tests:

Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."

Test the following systems:

a. Supply air.

Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

Test for leaks before insulation application.

5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

Visually inspect duct system to ensure that no visible contaminants are present.
Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/1 00 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 DUCT CLEANING

Clean new duct before testing, adjusting, and balancing.

Use service openings for entry and inspection.

Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 15 Section "Duct Accessories" for access panels and doors.
Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Clean the following components by removing surface contaminants and deposits:

Air outlets and inlets (registers, grilles, and diffusers).
Supply, return, and exhaust fans including fan housings, scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
Furnace and coil internal surfaces and components including, coil section, filters and filter sections, and condensate collectors and drains.
Coils and related components.
Return-air ducts, dampers, actuators, and turning vanes.
Supply-air ducts, dampers, actuators, and turning vanes.

3.8 DUCT SCHEDULE

Fabricate ducts with galvanized sheet steel except as follows:

Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

Liner:

1. Supply- and Return-Air Ducts: Fibrous glass, Type I, 1 inch thick.

Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

   a. Velocity 1000 fpm or Lower:

      Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      Mitered Type RE 4 without vanes.

   b. Velocity 1000 to 1500 fpm:

      Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

      Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

   Rectangular Main to Rectangular Branch: 45-degree entry.
   Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees."

   Velocity 1000 fpm or Lower: 90-degree tap.
   Velocity 1000 to 1500 fpm: Conical tap.

F. Duct Schedule

Rectangular duct with liner:

a. Low pressure supply and return, exhaust.

Rectangular duct wrapped with insulation:

a. Fresh air.

3. Single wall round with wrapped insulation.

a. Low pressure supply and return.

END OF SECTION 233113

SECTION 233300 - AIR DUCT 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:

Backdraft dampers.
Volume dampers.
High Efficiency Take-Offs.
Motorized control dampers.
Turning vanes.
Flexible connectors.
Flexible ducts.
Duct accessory hardware.

B. Related Sections include the following:

1. Division 15 Section "HVAC Instrumentation and Controls" for electric damper actuators.

1.3 SUBMITTALS

A. Product Data: For the following:

Backdraft dampers.
Volume dampers.
High Efficiency Take-Offs.
Motorized control dampers.
Turning vanes.
Flexible connectors.
7. Flexible ducts.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1. Fusible Links: Furnish quantity equal to 10 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 to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT DAMPERS

A. Manufacturers:

Air Balance, Inc.
American Warming and Ventilating.
CESCO Products.
Duro Dyne Corp.
Greenheck.
Penn Ventilation Company, Inc.
Ruskin Company.
Air Rite.

9. Prior approved equal.

B. Description: Multiple-blade, parallel action gravity balanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.

Blades: 0.025-inch- thick, roll-formed aluminum.

E. Blade Seals: Neoprene.

Blade Axles: Galvanized steel.

Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

A. Manufacturers:

Air Balance, Inc.
American Warming and Ventilating.
Flexmaster U.S.A., Inc.
McGill AirFlow Corporation.
METALAIRE, Inc.
Nailor Industries Inc.
Penn Ventilation Company, Inc.
Ruskin Company.
Air Rite.
Prior approved equal.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. Standard Volume Dampers: Opposed-blade design, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
Blade Axles: Galvanized steel.
Bearings: Oil-impregnated bronze.
5. Tie Bars and Brackets: Galvanized steel.

D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 HIGH EFFICIENCY TAKE-OFF

Factory-manufactured rectangular-to-round or round-to-round 45 degree leading tap fabricated of 24 ga zinc-coated lockforming quality steel sheets meeting requirements of ASTM A 653, with G-90 coating.

One inch wide mounting flange with die formed corner clips, pre-punched mounting holes, and adhesive coated gasket.

C. Manual Volume Damper:

Single blade, 22 ga minimum.
3/8 inch minimum square rod with brass damper bearings at each end.

3. Heavy duty locking quadrant on 1-1/2 inch high stand-off mounting bracket attached to side of round duct.

D. Approved Manufacturers:

HETD-L by Daniel Manufacturing.
STO by Flexmaster USA Inc.
HET by Sheet Metal Connectors Inc.
Hercules.
Air-Rite.
Prior approved equal.

2.6 MOTORIZED CONTROL DAMPERS

A. Manufacturers:

Air Balance, Inc.
American Warming and Ventilating.
Duro Dyne Corp.
Greenheck.
METALAIRE, Inc.
Nailor Industries Inc.
Penn Ventilation Company, Inc.
Ruskin Company.
Air Rite.
Prior approved equal.

B. General Description: AMCA-rated, opposed-blade design; minimum of 0.1084-inch-thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch-thick, galvanized-steel damper blades with maximum blade width of 8 inches.

Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
Operating Temperature Range: From minus 40 to plus 200 deg F.

3. Provide closed-cell neoprene edging.

2.7 TURNING VANES

Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

1. Available Manufacturers:

   Ductmate Industries, Inc.
   Duro Dyne Corp.
   METALAIRE, Inc.
   Prior approved equal.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers:

   Ductmate Industries, Inc.
   Duro Dyne Corp.
   Ventfabrics, Inc.
   Prior approved equal.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.

Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

   Minimum Weight: 26 oz./sq. yd..
   Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

3. Service Temperature: Minus 40 to plus 200 deg F.

2.9 FLEXIBLE DUCTS

A. Manufacturers:

   Flexmaster U.S.A., Inc.
   Hart & Cooley, Inc.
   McGill AirFlow Corporation.
   Themaflex.

5. Prior approved equal.

B. Insulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor barrier film.

Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.

C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.10 DUCT ACCESSORY HARDWARE

Instrument Test Holes: Cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts.

Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where detailed.

Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

Provide balancing dampers at points on supply and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

Provide test holes at fan inlets and outlets and elsewhere as indicated.

Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

Connect diffusers to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

I. Connect flexible ducts to metal ducts with draw bands.

J. Install duct test holes where required for testing and balancing purposes.

3.2 ADJUSTING

Adjust duct accessories for proper settings.

Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 233300

SECTION 233713 - DIFFUSERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

This Section includes ceiling-diffusers and grilles.

Related Sections include the following:

1. Division 15 Section "Duct Accessories" for volume-control dampers not integral to diffusers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each product indicated, include the following:

Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

Diffuser, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

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 GRILLES

A. Fixed Face Ceiling Return, Exhaust, or Transfer Air Grille:

1. Products:

a. Price Industries; 535.

Titus; 355RL.
Krueger; S85H.
Tuttle & Bailey; T70D.
Nailor Industries

f. Or equal by:

Material: Steel.
Finish: Baked enamel, white.
Face Arrangement: 1/2 inch horizontal blade spacing.
Frame: 1-1/4 inches wide.

B. Sidewall Transfer Grilles

Finish – Standard white baked enamel.
Zero degree deflection.

3. Approved Manufacturers And Models

Price - 90-L
Titus - 30RL or 30 SL
Krueger - S480H
Metalaire - HD-RH
Tuttle & Bailey - T1 10 or equal by
Nailor

2.3 CEILING DIFFUSER OUTLETS

A. Rectangular and Square Ceiling Diffusers:

1. Products:

Price Industries; SMD.
Titus; TDC.
Krueger; SH.
METALAIRE, Inc., Metal Industries Inc.; 55005.
Tuttle & Bailey; MS.
Nailor

g. Or equal by:

2. Material: Steel.
3. Finish: Baked enamel, white.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

Examine areas where diffusers and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Install diffusers and grilles level and plumb.

Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, provide lay-in ceiling module. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers and grilles with airtight connections to ducts and to allow service and maintenance of dampers and air extractors.

3.3 ADJUSTING

A. After installation, adjust diffusers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 235100 - STACKS

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. Field-fabricated steel breechings.

1.3 SUBMITTALS

Product Data: For the following:

1. Guy wires and connectors.

Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1 .1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in stacks.

1.5 COORDINATION

Coordinate with structural drawings.

Coordinate installation of equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FIELD-FABRICATED STEEL STACKS

Provide an all welded steel stack from boiler transition outlet to above termination point above roof.

Fabricate stack according to SMACNA's "Guide for Steel Stack Design and Construction."

C. Fabricate stack from ASTM A-285 Black- 3/16” thick minimum steel.

2.2 GUYING AND BRACING MATERIALS

Cable: Three galvanized, stranded wires of the following thickness:

1. For ID Sizes 27 to 30 Inches: 7/16 inch.

Angle Iron: Three steel, 2 by 2 by 0.25 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions 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 APPLICATION

A. Field-Fabricated steel stacks: New Dual-fuel boilers.

3.3 INSTALLATION OF UNLISTED, FIELD-FABRICATED STEEL STACK

Suspend stack independent of boiler.

Install, support, and restrain according to seismic requirements.

Align stack at connections, with smooth internal surface and a maximum 1/8-inch misalignment tolerance.

Support new stack from building structure, see detail on drawing.

All field welded joints shall be thoroughly scraped and wire brushed to remove scale and rust.

Insulate interior stack as identified in section 15080 of the specifications complete with metal jacket.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

Clean stack internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish. This shall be provided before applying insulation.

Provide temporary closures at end of stacks that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 235216 - CONDENSING UNITS

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 one ground mounted exterior air-cooled condensing unit.

1.3 SUBMITTALS

A. Product Data: For condensing unit, include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control test reports.

Operation and Maintenance Data: For condensing unit to include in operation, and maintenance manuals.

Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

Product Options: Drawings indicate size, profiles, and dimensional requirements of condensing unit and are based on the specific system indicated.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Code for Mechanical Refrigeration."

1. Unit shall be designed to operate with HCFC-free refrigerants.

1.5 COORDINATION

Coordinate size and location of exterior concrete base. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

Coordinate installation of equipment isolation pads, supports, and wall penetrations. These items are specified in Division 7 Section "Roof Accessories."

C. Coordinate location of piping and electrical rough-ins.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

Compressor failure.
Condenser coil leak.

2. Warranty Period: Four 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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONDENSING UNITS, AIR COOLED, 2 TONS CU-1:

A. Manufacturers:

Carrier Corporation.
Trane Co.
York International Corp.
Prior approved equal.

B. Description: Factory assembled and tested, consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.

C. Compressor: Scroll, hermetically sealed, with rubber vibration isolators.

Motor: Includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

Compressor: Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.

Accumulator: Suction tube.

Refrigerant : R-134 and R-410A.

Condenser Coil: Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, with removable drain pan and brass service valves with service ports.

Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection.

F. Accessories:

Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.

Electronic programmable thermostat to control condensing unit and evaporator fan.

Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.

Filter-dryer.

High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.

Low Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F with time-delay relay to bypass low-pressure switch.

Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.

PE mounting base to provide a permanent foundation.

9. Thermostatic expansion valve.

G. Unit Casing: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

2.3 MOTORS

A. General requirements for motors are specified in Division 15 Section "Motors."

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 16 Sections.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate condensing units according to ARI.

1. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

2. Energy-Efficiency Ratio: Equal to or greater than prescribed by

ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

B. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

PART 3 - EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of condensing unit.

Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls and mezzanine floor, for suitable conditions where condensing unit will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Install unit level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

Install condensing units on concrete base. Concrete base is specified in Division 15 Section "Basic Mechanical Materials and Methods," and concrete materials and installation requirements are specified in Division 3.

C. Concrete Bases:

Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

D. Vibration Isolation: Mount condensing units on rubber pads with a minimum deflection of 1/4 inch. Vibration isolation devices and installation requirements are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

Install piping adjacent to machine to allow service and maintenance.

Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Division 15 Section "Refrigerant Piping."

Ground equipment according to Division 16 Section "Grounding and Bonding."

E. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

Perform electrical test and visual and mechanical inspection.

Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.

Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

5. Verify proper airflow over DX coil.

B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

C. Remove and replace malfunctioning condensing unit and retest as specified above.

3.5 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

Inspect for physical damage to unit casing.

Verify that access doors move freely and are weathertight.

Clean units and inspect for construction debris.

Verify that all bolts and screws are tight.

Adjust vibration isolation and flexible connections.

Verify that controls are connected and operational.

B. Lubricate bearings on fan.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

Measure and record airflow over coil.

Verify proper operation of condenser capacity control device.

Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

H. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain condensing unit.

END OF SECTION 235216

SECTION 235239 - WETBACK - SCOTCH MARINE TYPE FIRE-TUBE BOILERS

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

Provide and install the packaged Scotch Marine Wet-Back Boilers shown and scheduled on the drawings. Boiler #3 shall be additive alternate.

This Section includes packaged, factory-fabricated and -assembled boilers, trim, and accessories for generating steam with the following configurations and burners:

Horizontal, fire-tube boiler.
Combination gas and oil burner.

1.3 SUBMITTALS

Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

Wiring Diagrams: Power, signal, and control wiring.

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.

Source quality-control test reports.

Field quality-control test reports.

Operation and Maintenance Data: For boilers, components, and accessories to include in operation, and maintenance manuals.

Warranty: Special warranty specified in this Section.

G. Other Informational Submittals:

ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
Startup service reports.

1.4 QUALITY ASSURANCE

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.

ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

UL Compliance: Test Boilers for compliance with UL 726 and 795 Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 and shown on structural drawings.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace front- and rear-door refractories of boilers that fail in materials or workmanship within specified warranty period.

1. Horizontal, Fire-Tube Boilers: Refractory in front and rear doors, 10 years from date of startup by factory-authorized personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
Superior Boiler Company Seminole - 3 pass - 350 HP and 250 HP or equal by.
Cleaver-Brooks.
Sellers Engineering Co.
Prior approved equal.

B. SCOPE

This specification shall govern the construction, features, materials, fabrication, and inspection of “package type” shop assembled, horizontal Wetback - Scotch Marine Type boiler with burner assembly, all necessary appurtenances, controls and auxiliary equipment mounted in the maximum practical extent, as an integral unit on a steel base so as to make a complete self-contained assembly.

Any deviation from this specification shall be specifically noted in submittal.

C. GENERAL REQUIREMENTS

The boiler manufacturer shall provide all necessary equipment, accessories, parts, transportation, and services required by these documents.

The boiler manufacturer shall supervise and direct the building of the boilers and equipment, using the manufacturer’s best skill and attention. The manufacturer shall be solely responsible for construction means, methods, techniques, sequences and procedures and for coordinating all portions of the equipment.

C. Guarantee:

The boiler manufacturer shall guarantee the steam flow rate of 30,000 lbs/hr, each and 8,625 lb/hr for boiler #3 (alternate #1). While the boilers are being fired with natural gas and No. 2 oil at the specified operating conditions. See paragraph 2.9-A.5 for conditions.

Performance and efficiency tests shall be conducted after completion of start-up. The manufacturer shall have a representative in attendance at the time the tests are conducted.

All equipment shall be guaranteed against defective design, workmanship, or material for one year from date of initial operation.

Provide standard ten (10) year warranty on refractory in front and rear doors.

D. Standards and Codes:

Manufacturer shall ensure that the equipment shall comply with the latest provisions of laws, Codes and standards applicable to the equipment and boilers which are in effect on the construction date.

On points of difference within or between laws, Codes and standards, the law, Code or standard having the most stringent requirements shall govern.

The contractor shall promptly obtain and pay for all state and local taxes and approvals required for the equipment herein specified.

Nothing contained in the Specifications shall be construed as authority or permission to disregard or violate any Code, ordinance, statue or regulatory requirement.

5. The manufacturer shall not be relieved of obligations of the boiler and equipment to perform in accordance with these Documents by tests, in-

spections or approvals required or performed by persons other than the manufacturer.

6. The following regulatory codes, standards, and Publications, form part of this specification. All applicable components shall be designed and constructed in accordance with these codes, with additions or modifications as required by this specification.

ASME Boiler and Pressure Vessel Code
ASME Power Test Code
c. ABMA Manual of Industry Standards

7. All equipment shall comply with the state regulations governing the location where the equipment is to be installed. Including but not limited to

Utah Boiler and Pressure Vessel Code current edition
International Mechanical Code (IMC)
International Plumbing Code (IPC)
National Fire Protection Association (NFPA)

E. Instructions and Data Sheet

The manufacturer shall furnish 3 hard copies and 1 electronic (.PDF) copy of operating instruction manuals, certified prints, ASME Manufacturer's Data Sheets and operation test data. This documentation shall be provided at the completion date.
The manufacturer shall include in the certified drawings the following design information:

	12,075 lb/hr	8,625 lb/hr
A. Boiler Design Pressure, psig Inside Diameter, in Straight Length, ft Material (ASM E Specification) Wall Thickness, in Corrosion Allowance, in Weight empty, including internals, lb Normal Water Level, in Maximum Water Level, in Minimum Water Level, in		
B. Vendor Supplied Piping to Terminal Points Material (ASME Specification) Inside Diameter, in 3. Wall Thickness, in		

C. Feed Stop and Check Valve Manufacturer Number Supplied Size inches Figure Number		
D. Relief Valves Manufacturer Quantity Size inches in -out Figure Number 5. Capacity @ Relief Conditions		
E. Vent and Drain Valves Manufacturer Quantity Size inches Figure Number		
F. Bottom Blowoff Valves Manufacturer Quantity Size in Figure Number		
G. Trim Valves Manufacturer Quantity Size in Figure Number		
H. Surface Blowdown Valves Manufacturer Quantity Size in Figure Number		
I. Gauge Glasses Manufacturer Quantity 3. Model Number		
J. Furnace Tube Design Gas side Pressure/Vacuum, in H_2O Design Maximum Exit Gas Velocity, ft/min Maximum Heat Release per sq. ft. of Ef fetive Heating Surface, Btu/sq. ft-hr. 5. Furnace Volume, ft^3		

F. Site Visit to Plant

Manufacturer shall provide in his proposal the cost for three (3) persons to visit the manufacturer's plant during the time of boiler construction. The Vendor shall conduct required tests and pre-assemble appropriate components prior to shipment. The Owner and his Engineer shall have access to the Vendors plants for the purpose of inspecting the work on equipment to be furnished by the Vendor. The Vendor shall notify Owner 5 working days in advance before visit.

2.2 DESIGN REQUIREMENTS

A. Operating Conditions

Design Continuous Capacity . .Boilers 1 and 2 . . . . . 12,075 LB/HR
Design Continuous Capacity . .Boilers 3 (Alternate 1) . . . . . .8,625 LB/HR
Design Pressure . . . . . 250 PSIG
Operating Pressure . . . . . 125 PSIG
Feedwater Temperature . . . . . 227°F
Elevation above Sea Level. . . . . 4350 Ft
Electrical Characteristics. . . . . 208 Volts . . . 3 Phase . . . 60 Hertz
Primary Fuel . . . . . Natural Gas 17 PSI
Standby Fuel . . . . . Fuel Oil #2
Insurance Requirements. . . . . State of Utah

B. Fuel

Boilers shall be designed to operate using No. 2 light fuel and natural gas. Fuel oil will be supplied at 100 PSIG. Natural gas will be supplied at 17 PSIG.
In determining the performance of the boiler and in the absence of specific fuel analysis, the following ultimate analyses shall be used.

	No. 2 Fuel Oil
BTU	19,300 BTU/LB/140,000 BTU/GAL.
Carbon	87.0% by wt.
Hydrogen	12.5% by wt.
Sulfur	0.05% by wt.
Nitrogen	0.02% by wt.
Oxygen	0.55% by wt.

	Natural Gas
BTU	870 BTU/CF
Methane, CH_4	90% by volume
Ethane, C_2H_6	5% by volume
Nitrogen, N_2	5% by volume

C. General Conditions:

This specification covers the construction of a steam generating unit to

develop the above stated maximum steam capacity.
Material shall be as specified herein. Material not specifically stipulated shall be of the best commercial quality. All materials shall be free from defects that might affect the serviceability of the finished product.
The equipment shall be essentially the standard product of the manufacturer so prompt and continuous service can be assured. The accessory equipment or component parts of the unit need not be the product of the same manufacturer.
Saturated steam leaving the boiler steam drum shall not contain more than (1/2 of 1%) 5% moisture with boiler water concentrations not exceeding the values as recommended by the ABMA for the applicable operating pressure.

2.3 MANUFACTURED UNITS

Description: Factory-fabricated, -assembled, and -tested, horizontal, fire-tube boilers with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket, flue-gas vent, water supply and return connections, and controls.

Pressure Vessel Design: Straight, steel tubes attached to the tubesheets by flare rolling and then beading the tubes to the tubesheets. Three passes with wet-back design. Minimum heat-exchanger surface of 5 sq. ft./bhp. Include the following accessories:

The boiler shall be mounted on a structural steel base with a forced draft burner and burner controls. The boiler shall be designed, constructed and tested in accordance with the latest edition and addenda of the A.S.M.E Boiler and Pressure Vessel Code and shall be registered with the National Board of Boiler and Pressure Vessel Inspectors.

The boiler shall be designed for 150 PSI steam with an operating pressure of 100 PSI in accordance with the latest edition and addenda of Section I of the A.S.M.E Boiler & Pressure Vessel Code.

The steam boiler shall be completely pre-assembled and firetested at the factory to check construction, controls and combustion characteristics of the unit.

Boiler #3 - 250 HP shall be constructed to meet the requirements of CSD -1,
Boiler #3 - 350 HP shall be constructed to meet the requirements of IRI.

5. The steam boiler shall be designed to produce a steam quality of 99% at all firing rates.

C. Structural Design

1. The furnace shall be located in the bottom third of the boiler to provide for maximum heat transfer while being in contact with the coolest boiler water.

All boilers shall have a furnace of the Morrison corrugated design. The flue gas turnaround area shall not to be included in calculating furnace volume.

All tubes shall have a minimum wall thickness of .105" and have an OD of 2-1/2". First pass of tubes is of XID type (extended internal heating surface). The tubes shall be attached to the tubesheets by flare rolling and then beading the tubes to the tubesheet.

All tubesheets shall be a minimum of 3/4 of an inch to insure a tight seal between the tube and the tubesheet.

The boiler shall be mounted on a seismic heavy structural steel base with extended runners on the front to provide burner support and protection.

The rear legs shall be slotted to provide for expansion when the boiler goes from a cold situation to a hot situation.

All heating surfaces shall be fully accessible for inspection and cleaning without disturbing the burner equipment. A 17" diameter access opening complete with a gasketed plug and a Pyrex observation port and shutter shall be provided to allow for access into the turnaround and furnace. The plug shall be equipped with handles and the shutter assembly shall have a 1/8" tapping for the field connection of a manometer.

All necessary handholes and manholes shall be provided in accordance with the ASME Code. Provide two additional handholes in the front tubesheet near the bottom of the boiler on either side of the furnace.

The front and rear tubesheets shall be fully accessible for inspections or cleaning when the front or rear doors are open. Opening of the doors, two in front and two in back, shall not be impeded by any fuel lines, door plates, baffles, linkage or electrical connections. The doors shall have davited hinges and be insulated with a 1" think ceramic fiber blanket. The insulating blanket shall have a R factor of .44 and be coated with a hardener to prevent erosion from the flue gases. All doors shall be held in place by lugs that are secured by replaceable brass nuts. The doors shall be sealed gas tight with nonproprietary ceramic fiber rope with a minimum density of 20 lbs. per square foot and a continuous use limit of 1800°F.

The boiler shell shall be insulated with two inch thick, eight pound per cubic foot density mineral wool with a R factor of .27. The insulation shall be held in place by bands and covered with a 22 gauge phosphate coated galvanized steel jacket. All openings in the jacket shall have trim rings. The area on the rear tubesheet under the access doors shall be insulated with the same insulation and covered with 22 gauge phosphate coated galvanized steel jacket.

The entire boiler shall be painted with a high temperature, 500 degrees F minimum, acrylic silicone based paint. The front and rear doors shall be sand blasted before painting and the jacket primed with a vinyl wash primer before painting.

12. All boilers shall have a 12" X 16" manway located along the top centerline of the boiler to facilitate waterside cleaning and inspection. The top of the boiler furnace shall be visible when the manway cover is removed from the boiler shell.

D. Connections

1. The boiler shall have two 11/2" bottom blowdown connections for boilers #1 and #2, and two 11/4" bottom blowdown connections for boiler #3.

Boilers shall be supplied with one factory piped and installed quick opening

blowdown valve per blowdown connection, and one slow opening valve per boiler. The piping shall be documented on the Manufacturer's Data Report.

Each boiler shall be equipped with two lifting eyes.

Two 2" feedwater connections on the horizontal center lines shall be provided, one on each side of the boiler. Each connection shall be furnished with an internal baffle.

One set of feedwater valves (one gate valve and one check valve), the same size as the boiler feedwater connection, shall be factory piped and installed on one of the feedwater connections, see drawings. The piping shall be documented on the Manufacturer's Data Report. Plug the other connection not used with code cap.

A 23 1/8" diameter flue gas connection shall be located at the rear of the boiler on the top centerline for boilers #1 & #2. Flue gas size for boiler #3 is 19 7/8" diameter. The stack shall be designed for easy attachment of the exhaust flue by a flange connection. The flue gas connection shall be designed to support a minimum of 2,000 lbs of dead weight. The stack shall have a 1/2" connection for a stack thermometer or transmitter.

A one-inch surface blowdown connection complete with a dip tube shall be provided.

One set of surface blowdown valves (a gate type shutoff valve and a calibrated flow control valve) shall to be factory piped and installed on the boiler. The piping shall be documented on the Manufacturer's Data Report.

The steam connection shall be 6" class 300# Section 1.

The boiler shall be supplied with a low fire hold connection located in the bottom third of the shell.

Boiler steam connection shall also be provided with code piping, non return valve, spool piece with drain and gate valve.

E. Boiler Trim

A float type primary low water cut-off and pump control shall be provided with a gage glass, ball check gage glass valves, try cocks and a ball type water column blowdown valve.

A probe type secondary low water cut off shall be provided.

A high limit with manual reset shall be provided in addition to the operating control.

A firing rate controller shall be provided.

Provide relief valves set at a minimum of 17% higher than the operating pressure of the boiler, but no higher than the boiler design pressure.

A pressure gauge with an inspector's test cock shall be provided.

F. Factory Firetest

1. The factory firetest shall be a complete functional test conducted at 100 PSIG and, at a minimum, shall consist of filling the boiler with water and operating the burner throughout its complete range of operation. Additionally, all of the components wired into the boiler safety control circuit shall be tested by simulating a failure condition. A copy of the firetest report shall be included in the manual.

2. Upon completion of the factory firetest, the boiler shall be cooled and hydrostatically tested and the boiler external piping documented. The unit shall

be ready for installation and final connection of water, steam, fuel, blowdown, electrical and flue.

2.4 BURNER

Burner: Welded construction for No. 2 fuel oil and natural gas.

Manufacturer's: Subject to compliance with requirements. Provide products by one of the following.

Power flame models LNICM9A-G10-30 for boilers #3 and LNICM9B-G10-30 for boilers #1 and #2 or equal by:
Prior approved equal.

C. General Requirements

Furnish and install three Underwriters Labeled combination gas/light oil burners. The burner design, construction, components and installation shall meet all applicable code requirements. Boiler #3 burner shall be alternate #1.
The new burner system shall be installed in Scotch Marine type boilers.

3. The burner shall be mounted to fire on the centerline of the boiler furnace.

D. General Burner Description

1. The burner shall be Power Flame or approved equal forced draft flame Burners for boilers 1 and 2 shall be capable of burning 14,645 CFH of natural gas, boiler #3 (alternate No.) shall be capable of burning 10,461 CFH of natural gas. Gas pressure applied to the burner gas train supply connection shall be a minimum of 17 PSIG at full high rate. Each burner for boilers 1 and 2 shall be capable of burning 3.5 GPM No. 2 fuel oil. Boiler No 3 burner (Alternate No 1) shall be capable of burning 2.5 GPM of No 2 fuel oil.

Approval Codes

1. Each burner shall be listed by Underwriters Laboratories and shall bear the appropriate U.L. label (in addition to the U.L. requirements, all equipment and installation procedures will meet the requirements of ASME CSD-1 Boiler No. 3 and NFPA 8501 for boilers No 1 and No 2. Each burner shall be designed and constructed as an integrated combustion system package and shall be factory fire tested.

Combustion Head Design

1. Each burner shall be of welded steel construction and have a baked on powder coat finish. The combustion head shall incorporate a multi blade, stainless steel, flame retention diffuser. The gas firing head shall include a series of gas injection spuds that distribute the fuel evenly around the periphery of the diffuser assembly. A gas annulus shall provide a secondary layer of fuel to create a

staging effect to achieve maximum fuel/air mixing and minimal emissions. Burners with cast alloy blower housings are acceptable. The burner combustion head will carry full five (5) year replacement warranty.

The burner design shall include an adjustable sleeve for setting the secondary gas and varying the primary air/gas mix within the combustion zone. The burner combustion head components shalll be easily accessible through an access door located on the side of the burner blast tube. The burner combustion head components shall be easily adjusted or replaced, and the oil gun assembly maintained without having to disconnect fuel supply piping or electrical connections to the burner assembly.

All air required for combustion shall be supplied by a blower mounted integral to the burner. The blower wheel shall be of the backward inclined centrifugal design. A multiple blade damper assembly located on the inlet side of the blower wheel shall meter the combustion air flow. Prove contracts for control circuit to atomic CA dampers, so when burners are on the dampers will open and when the burners are off the dampers close.

Ignition System

1. The burner ignition system, which will light either the main gas or oil flame, shall utilize natural gas as the fuel source. The gas pilot system components shall include spark ignited pilot assembly, 6000 Volt ignition transformer, pilot solenoid valve, pilot gas pressure regulator and manual gas shutoff cock. The flame proving system shall incorporate an Ultra-Violet flame detector, which will monitor both the pilot and main flames. The pilot assembly shall fit within the confines of the blast tube -avoiding special burner front plate pilot cut outs.

Fuel/Air Control System

1. Modulation

The main On-Off gas supply shall be controlled by a motorized gas valve. The main On-Off oil supply shall be controlled by a solenoid oil valve. A modulating motor shall control the modulated positioning of the air inlet dampers at the burner, butterfly type gas proportioning valve and a metering type oil valve, to best meet varying system load conditions.

Provide a Cam actuated Characterized Fuel Metering device, which will be an integral part of the burner fuel metering system. The system shall be U.L. listed and capable of providing an adjustable and accurately repeatable fuel/air ratio throughout the burner's full firing range. The system shall be capable of providing a constant fuel/air ratio, or a linearly adjusted fuel/air ratio, in order to satisfy individual burner application requirements. Each system shall be complete with fourteen (14) separately adjustable cam development set-points. Each set-point shall be complete with locking set screw. The cam follower shall be equipped with a double spring set, in order to insure maximum reliability. All bearing points shall be provided with oil impregnated bronze bushings, requiring no field lubrication.

c. The positioning of the modulating motor shall be controlled by a 135 Ohm, or 4-20 milliamp, or 0-10 VDC, modulating type controller. When the

operating control is satisfied the burner shall shutoff and return to the low fire start position. The modulating motor shall provide an electrical interlock to insure a guaranteed low fire start position prior to the pilot trial for ignition sequence.

I. Gas Control Train

IRI Requirements

The gas valve train shall contain the following:

Manual Shutoff cock

Main gas pressure regulator with tight shut-off type. Provide (5) pipe diameters of straight uninterrupted pipe on the outlet side if using PRV with internal control.

Automatically operated main gas valve, with motorized operators.

Automatically operated main motorized gas valve with proof of closure switch and motorized operators

U.L. listed leak test cock.

Automatically operated auxiliary gas valve.

Manual reset Low and High Gas Pressures switches.

Manual leak test cock.

Burner manifold gas pressure gauge and gauge cock.

Automatically operated Normally Open Vent Valve.

J. Oil Control Train

General Requirements The oil train shall incorporate U.L. approved components as supplied by the burner manufacturer to provide specified Fuel/Air Control System operation capable of an 8:1 turndown.

Fuel flow to the air atomizing nozzle shall be delivered by a single or two stage gear type pump capable of producing 120 PSIG discharge pressure and 15 in. hg. vacuum. It shall be a separate unit mounted on its own support base with direct drive motor. The unit shall be complete with suction line manual gate valve, removable mesh type oil strainer, 0-30" HG. 0-30 PSIG vacuum/pressure gauge with gauge dampening orifice, 0-100 PSIG oil nozzle pressure gauge with gauge dampening orifice and nozzle line solenoid safety shutoff oil valve.

3. Additional oil components shall be provided as follows:

Oil nozzle line auxiliary solenoid safety shutoff oil valve.

Low oil pressure switch.

4. Burner mounted air atomizing piping train shall consist of solenoid shutoff valve, low atomizing air pressure switch and pressure gauge.

A separate piston type air compressor set with pressure indicating gauge shall be provided. Rotary vane air compressors are not acceptable

For burners above 12,500 MBH, both valves shall have proof of closure and FM label.

K. Burner Operating Controls

The On-Off operation of the burner shall be controlled by a pressure control.

A safety manual reset type limit control shall be provided to shut the burner down in the event of excessive pressure.

3. Modulation. The position of the modulating motor and other fuel/air components shall be controlled by a 135 Ohm, or 4-20 milliamp, or 0-10 VDC, pressure control in addition to the On-Off operating control.

L. Interlocks

For U.L. Modulation. The modulating motor shall be sequenced to allow for four (4) complete air changes of the combustion chamber and breaching, and through an integral end switch be electrically interlocked with the control burner circuit to insure the fuel/air linkage is in the low fire start position before burner ignition sequence can begin.

A fresh air louver end switch electrical interlock shall be provided in the burner operating circuit which will insure that the fresh air louvers are open before the burner can operate. Boiler room freeze protection circuit shall be provided to close the fresh air intake in the event of a flame failure.

3. The induced draft fan operation will be electrically interlocked with the burner operating circuit to insure that the burner will not operate if the draft fan is not operating or if the draft is below a preset level.

M. Product Liability Insurance

1. The burner manufacturer will provide an Insurance Certificate documenting his current coverage of Product Liability Insurance.

Burner Start Up Information and Test Data

1. On completion of the burner system start up -the installing contractor along with the factory representative will complete the "Burner Start Up Information and Test Data" form and "Control Settings" form (both attached) and deliver to the Architect.

NOx Emissions Reduction -Low NOx Burner

Burners must be low NOx type, U.L. listed specifically for reduced emissions service. Burner NOx reduction strategy shall reduce the production of NOx by controlling low excess air operation and reducing flame temperature. Optimum stoichiometry shall be maintained by a Varicam operated fuel metering control with characterized cams for each fuel. Each cam shall have 14 points of adjustment through the modulating range assuring NOx reduction and high fuel efficiency.

Internal recirculation and staged air burners, where portions of the main flame are combusted within the burner head, behind a cone or diffuser assembly shall not be acceptable due to the potential for burner head failure caused by the resultant thermal stress of the referenced components.

3. Steam injection emissions reduction burners will not be acceptable because of the potential of mineral deposits on, and/or damage to heat transfer surface and refractory -and also due to the cost of steam.

4. Low NOx Burner(s)

a. Type: Induced Flue Gas Recirculation (IFGR).

Each burner shall be equipped with a burner mounted induced FGR purge assembly, complete with motor driven diverter damper to ensure that FGR is not introduced into the burner combustion air during the pre-purge, ignition, initial main flame establishment, or post purge cycles.

Induced FGR piping shall be furnished and installed by the boiler manufacturer and connected into the boiler and the burner FGR inlet connection. FGR piping shall be seamless carbon steel pipe or tubing, minimum Schedule 10, sized in accordance with the burner manufacturers recommendations and run to avoid interference with flue doors, boiler inspection parts, etc. Piping insulation shall be provided by contractor.

On natural gas firing, NOx emissions shall not exceed 30 PPM, and CO emissions shall not exceed 50 PPM. NOx emissions on oil firing shall achieve up to a 40% reduction of NOx emissions, from that experienced without NOx control, with CO not exceeding 100 PPM. All emissions measurements are to be corrected to 3% O2.

Burner Start-Up Information and Test Data Form must include NOx and CO emissions measurements. Form, completed with all test data values, shall be furnished to the owner prior to final payment.

BURNER START UP INFORMATION & TEST DATA

The following information shall be recorded for each burner start up:

Power Flame Model Job No. Serial No.

Installation Name Start Up Date

Start Up Contractors Name Phone

Name of Technician doing Start Up

Type of Gas: Nat.

LP Other Fuel Oil Grade No.

Gas Firing Oil Firing Gas Pressure at Train Inlet High Fire Vacuum Reading on Oil

Burner in Off Position “W.C. Pump Inlet “H.G.

Low Fire “W.C.

High Fire “W.C. Gas pressure at Pilot Train

Inlet (if applicable) “W.C.

Gas Pressure at Firing Head Low Fire “W.C. Gas Pressure at Pilot Test High Fire “W.C. Tee (if applicable) “W.C.

Gas Pressure at Pilot Test

Tee “W.C.

Flame Signal Readings D.C. Volts

Oil Nozzle Supply Pressure

Low Fire PSIG High Fire PSIG

Micro Amps Pilot Oil Nozzle Atomizing Medium Pressure Control Settings Gas

Low Fire

High Fire

CO_2or (Specify)

O_2 Low Fire %

High Fire %

CO

Low Fire PPM

High Fire PPM

Input Rate Low Fire

BTU/HR

High Fire BTU/HR

Overfire Draft

Low Fire "W.C.

High Fire "W.C.

NOx (Corrected to 3% O_2) Low Fire

PPM

High Fire PPM

Stack Outlet Test Point Draft

Low Fire "W.C.

High Fire "W.C.

Net Stack Temperature Low Fire

° F

High Fire ° F

Combustion Efficiency Low Fire %

High Fire %

Windbox O_2 (Low NOx Only) Low Fire %

High Fire %

Low Fire PSIG

High Fire PSIG

Flame Signal Readings Pilot (if applicable)

D.C. Volts

Low Fire

High Fire

GPH Firing Rate

Low Fire GPH

High Fire GPH

CO_2 or O_2 (Specify)

Low Fire %

High Fire %

Bachrach Scale Smoke Number

Low Fire

High Fire

NOx (Corrected to 3% O_2)

Low Fire PPM

High Fire PPM

Over Fire Draft

Low Fire "W.C.

High Fire "W.C.

Stack Outlet Test Point Draft

Low Fire "W.C.

Net Stack Temperature Low Fire

High Fire

Combustion Efficiency Low Fire %

High Fire %

Operating control cut out setting Operating control cut in setting

Low gas pressure switch High gas pressure switch "W.C.

"W.C.

Other

Limit control cut out setting
Limit control cut in setting

Power supply: Volts Control Ph Hz circuit: Volts Blower motor amps at high fire Other

Oil Low oil pressure switch High oil pressure switch Atomizing low pressure switch

lbs.
lbs.
lbs.

Oil pump motor amps at high fire Other

Operation Checklist Yes No Barometric damper Boiler room combustion air & ventilation provision correct Oil tank vent system correct All oil lines checked for leaks All gas lines checked for leaks Gas lines & controls properly vented Other system components (specify)

Yes | No

Checked For Proper Operation Of: Low water cut off High water cut off Flame safeguard control ignition failure Flame safeguard control main flame failure Burner air flow switch Induced draft fan controls Over fire draft controls Fresh air damper end switch

Notified of the following system deficiencies:

Comments to the Specification Writer on FM and IRI Code Requirements

Factory Mutual (FM) Insurance Requirements

Local FM inspectors are empowered to examine risks and impose or modify requirements which could result in substantial equipment (and price) change depending on decisions of the local inspector.

Purchasers (owners), or their consulting engineers, should contact the local FM office to determine any items, not included above, which must be supplied.

All systems specified are subject to acceptance by the local FM inspector.

Industrial Risk Insurers (IRI) Insurance Requirements

The equipment specified in the attached under IRI incorporates the basic components and systems necessary to comply with the published standards.

Local IRI inspectors are empowered to examine the risks and modify the standards which could result in equipment (and price) change depending on the decision of the local inspector. Purchasers (owners), or their consulting engineers, should contact the local IRI office to determine any items, not included above, which must be supplied.

All systems specified are subject to acceptance by the local IRI inspector

2.5 CAPACITIES AND CHARACTERISTICS

Heating Medium: Steam.

Design Pressure Rating: 250 psig.

Entering Boiler Feed-Water Temperature: 227 deg. F.

Steam Operating Pressure: 100 psig.

Steam Flow Rate: Boilers #1 and #2 - 12,075 lb/hr (ea), Boiler #3 - 8,625 lb/hr - Alternate #1.

Number of Passes: Three.

AGA Input: Boilers #1 and #2 - 14,645 CFH, Boiler #3 -10,461 CFH - Alternate #1.

Oil Input: Boilers #1 and #2 - 3.5 gpm, Boiler #3 - 2.5 gpm - Alternate #1.

I. Burner Blower:

1. Motor Horsepower: Boilers #1 and #2 - 7.5 HP, Boilers - 5HP - Alternate #1.

2.6 SOURCE QUALITY CONTROL

Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

PART 3 - EXECUTION

3.1 EXAMINATION

Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

Examine mechanical spaces for suitable conditions where boilers will be installed.

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

3.2 BOILER INSTALLATION

A. Install boilers level on concrete base. Concrete base provide by General Contractor. The contractor to provide the 3/4” diameter bolts X 14” long anchor bolts. Epoxy bolts in concrete base.

Vibration Isolation: Elastomeric isolator pads with a minimum static deflection of 0.25 inch. Vibration isolation devices and installation requirements are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

Install oil and gas-fired boilers according to NFPA 31 and 54.

Assemble and install boiler trim if shipped loose.

Install electrical devices furnished with boiler but not specified to be factory mounted.

F. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

Install piping adjacent to boiler to allow service and maintenance.

Connect gas piping to boiler gas-train inlet with union or flange. Piping shall be at least full size of gas train connection. Provide a reducer if required.

Connect oil piping full size to burner inlet with shutoff valve and union.

Connect boiler feed-water piping to boiler tappings with boiler provided gate and check valves.

Connect steam piping to boiler supply connection with code piping to boiler supplied non return valve, spool and drain and gate valve.

G. Install piping from safety relief valves thru roof to the exterior.

Install piping from safety valves to drip-pan elbows as shown and detailed on drawings.

Install piping from equipment drain connection to nearest trench drain. Piping shall be at least full size of connection. Provide an isolation valve.

Connect breeching full size to boiler outlet. Comply with requirements in Division 15 Section "Breechings, Chimneys, and Stacks" for venting materials.

Install flue-gas recirculation duct from boiler to burner. FGR piping provided by boiler manufacturer. Contractor shall install if shipped loose from factory.

Ground equipment according to Division 16 Section "Grounding and Bonding."

Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

Tests and Inspections:

Perform installation and startup checks according to manufacturer's written instructions.

Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.

Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.

Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and steam pressure.

c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

Remove and replace malfunctioning units and retest as specified above.

Performance Tests:

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.

Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment in order to comply.

3. Perform field performance tests to determine the capacity and efficiency of boilers.

For dual-fuel boilers, perform tests for each fuel.

Test for full capacity.

c. Test for boiler efficiency at low fire, 20, 40, 60, 80, 100, 80, 60, 40 and 20 percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.

Provide analysis equipment required to determine performance.

Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.

Coordinate with DFCM, Architect, Engineer, Boiler Inspector and user on test dates.

Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Video training sessions.

END OF SECTION 235239

SECTION 235316 - DEAERATORS AND SURGE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

This Section includes one packaged, factory-assembled deaerator as sized and scheduled on the drawings, and one packaged, factory-assembled condensate.

Surge tank as sized and scheduled on the drawings.

1.3 DEFINITIONS

Boiler Feedwater Pump: Pump that moves feedwater from the deaerator to the boiler.

Transfer Pump: Pump that moves feedwater from the condensate surge tank to the deaerator.

C. NPSH: Net-positive suction head.

1.4 SUBMITTALS

Product Data: For each type of product indicated. Include rated makeup water, feedwater, and steam flow rates; working pressure; tank capacities; storage capacity in minutes; temperature and NPSH required; pump performance curves with selection points clearly indicated; furnished specialties; and accessories.

Shop Drawings: For deaerator and surge tank packages, signed and sealed by a qualified professional engineer; include plans, elevations, sections, details, dimensions, weights, loadings, required clearances, and attachments to other work.

For installed products indicated to comply with design loads, include structural analysis data.
Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing the deaerator and surge tank bases.
Wiring Diagrams: Power, signal, and control wiring.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

5. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Field quality-control test reports.

Operation and Maintenance Data: For deaerator and surge tank packages to include in operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

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.

ASME Compliance: ASME B31.1, "Power Piping. Safety valves and pressure vessels shall bear the appropriate ASME label.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect flanges, pipe openings, nozzles, bearings, and couplings from damage during shipping and storage.

Comply with manufacturer's written rigging instructions.

C. Deliver deaerator and surge tank packages as factory-assembled units with protective crating and covering.

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.

Gaskets: Furnish one replacement gasket(s) for each gasketed opening.
Gage Glass: Furnish one replacement glass(es) for each gage glass.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Lockwood Products, Inc.; Sub. of John L. Underwood Co., Inc.
Cleaver-Brooks; Div. of Aqua-Chem Inc.
Cochrane, Inc.; a Crane Co. Company.
Sellers Engineering Co.
Shipco.
Prior approved equal.

2.2 MANUFACTURED UNITS

Vertical, packed-column, single-compartment deaerator, and a separate packaged surge tank assembly with transfer and feedwater pumps and controls to supply feedwater to deaerator.

Material for Wetted Components: Components in contact with water that has not been deaerated shall be made of Type 316 stainless steel.

Adjustable Spray Valves: Type 316 stainless steel. Arrange spray valves for counterflow of steam and condensate and so corrosive gases being vented do not contact deaerator's head or shell.

Vent Condenser: Stainless steel, with automatic and manual vent valves.

E. Deaerator and Storage Tank:

Material: Welded carbon steel.
Additional Corrosion Protection:
a. Electrolytic corrosion-inhibitor anode.

Access: Manhole in deaerator and storage tank for access to internal components for inspection and service.
Factory-Installed Pipe, NPS 2-1/2 and Smaller: ASTM A 53/A 53M, Type S (seamless), Grade B; or ASTM A 106, Type S, Grade B, Schedule 80; with threaded joints and fittings.

Cast-Iron Threaded Fittings: ASME B16.4, Class 250.
Malleable-Iron Threaded Fittings: ASME B16.3, Class 300.
Forged-Steel Fittings: ASME B16.1 1, Class 3000.
Malleable-Iron Unions: ASME B16.39, Class 300.
e. Forged-Steel Unions: MSS SP-83, Class 3000.

F. Accessories:

Lifting eyes.
Companion flanges.
Pump suction piping with vortex breaker, isolation valve, strainer, and connection to vertical pumps.
Pump-discharge bypass orifice plate.

5. Makeup Water Assembly:

Factory-mounted modulating valve with mechanical level control, external float cage, and stainless-steel float.
Factory-mounted or shipped, three-valve bypass and inlet strainer.

6. Steam Pressure-Reducing Valve: Steam operated, and sized to reduce boiler outlet pressure to the deaerator design pressure.
Tank Overflow Drain: Sized to relieve full capacity at operating pressure.
Safety Valve(s): ASME labeled and sized to relieve full capacity of pressure-reducing valve.

Vents: Manual and automatic vent valves.
Vacuum breaker.

11. Meters and Gages:

Full-height, water-level gage glass and stop valve set.

Bimetal dial-type thermometer graduated in Fahrenheit mounted to measure temperature in storage and steam section of tank.

c. Pressure gage graduated in pounds force per square inch mounted to measure pressure in steam section of tank.

12. Provision for chemical injection quill.

Chemical injection quill.
Sampling connection with valve.
Tank drain connection with valve.
Oxygen test kit.

Support Frame: Structural-steel frame for supporting tank and pumps. Bolt to tank.

1. Fabricate support frame with bracing adequate for seismic forces according to authorities having jurisdiction and to allow installation by anchoring deaerator to floor only.

Feedwater Pumps provide four (4): Cast-iron, flange; with stainless-steel, multistage centrifugal impellers, renewable bronze case ring, and stainless-steel shaft.

Seals: Mechanical, suitable for 250 deg F.
Pump Motor: Vertical, open dripproof enclosure, close coupled to pump. Comply with requirements in Division 15 Section "Motors."

I. Feedwater Pump Control Panel: Factory mounted and wired and including the following:

NEMA 250, enclosure.
Single-point, field power connection.

a. Branch power circuit to each motor and to controls provided by manufacturer.

NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection for each motor.

a. Alternating control as indicated by control sequence for each pump.

Terminal blocks with numbered and color-coded wiring to match wiring diagram.
Raceway for factory-installed wiring outside of enclosures. Make connections to motor with liquidtight conduit.
Removable control mounting plate.
Visual indication of status and alarm.
Audible alarm and silence switch.
Visual indication of elapsed run time, graduated in hours.
Fusible, control-circuit transformer.

11. Microprocessor-based controller.

J. Feedwater Pump Start-Stop Control Sequence:

Boiler water-level controller for each pump shall start and stop the boilers feedwater pump servicing that boiler, to maintain boiler water-level set point.
Pump failure shall automatically start the standby pump.
Visual indication of pump on and off status.
Visual and audible alarm indication of pump failure.

K. Feedwater Pump Continuous Control Sequence:

Each pump will be matched to a boiler ie. BFP-1 connected to boiler #1, BFP - 2 connected to boiler #2, BFP - 3 connected to boiler #3 and BFP-4 connected to all boiler as standby.
Pump shall run continuously while its respective boiler operates. Electric interlock with boiler control starts pump when boiler starts.
Boiler water-level controller modulates feedwater control valve applied by boiler manufacturer shall maintain boiler water-level set point. Valve automatically closes when boiler is off.
Individual boiler pump failure automatically starts the standby pump.
Feedwater pressure controller starts and stops the standby pump to maintain feedwater pressure set point.
Visual indication of pump on and off status.
7. Visual and audible alarm indication of pump failure.

L. Makeup Water Control Sequence:

Electric level controller operates electric control valve to maintain tank water-level set point.
Visual and audible alarm indication of low and high tank water level.

M. Boiler Management System Interface: Factory installed hardware to enable building management system to monitor and display points.

1. Hardwired Monitoring Points: On/off status for each pump, failure alarm for each pump , low-water level alarm , high-water level alarm and feedwater temperature.

2.3 SURGE TANK

Description: Packaged factory-assembled and -tested unit consisting of a condensate receiver tanks transfer pumps, control panel, piping and openings to match system return piping sizes noted on the drawings. Provide the unit scheduled and shown on the drawings.

Accessories:

Bimetal dial-type thermometer graduated in Fahrenheit.
Level gage glass with stops at top and bottom.
3. Lifting eyes.

Companion flanges.

Pump suction piping with vortex breaker, isolation valve, strainer, and connection to vertical pumps.

Pump discharge piping with check valve, isolation valve, and liquid-filled pressure gage graduated in pounds force per square inch.

Pump-discharge bypass orifice plate.

C. Factory-Installed Pipe, NPS 2-1/2 and Smaller: ASTM A 53/A 53M, Type S (seamless), Grade B; or ASTM A 106, Type S, Grade B, Schedule; with threaded joints and fittings.

Cast-Iron Threaded Fittings: ASME B16.4.

Malleable-Iron Threaded Fittings: ASME B16.3.

Forged-Steel Fittings: ASME B16.1 1, Class 3000.

Malleable-Iron Unions: ASME B16.39.

5. Forged-Steel Unions: MSS SP-83, Class 3000.

D. Tank:

Material: Welded carbon steel.

Additional Corrosion Protection:

a. Electrolytic corrosion-inhibitor anode.

3. Access: Manhole in tank for access to internal components for inspection and service.

Support Frame: Structural-steel frame for supporting tank. Bolt to tank.

1. Fabricate support frame with bracing adequate for seismic forces according to authorities having jurisdiction and to allow installation by anchoring deaerators to floor only.

Transfer Pump: Vertical, flange-mounted, multistage, centrifugal pump; rated for 175-psig minimum working pressure and a continuous water temperature of 225 deg F; with the following features:

Impeller: Stainless steel.

Seals: Mechanical.

3. Motor: Open dripproof enclosure. Comply with requirements in Division 15 Section "Motors."

G. Transfer Pump Control Panel: Factory mounted and wired and including the following:

NEMA 250, Type enclosure.

Single-point, field power connection to circuit breaker.

a. Branch power circuit to each motor and to controls circuit breaker.

3. NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection for each motor.

a. Alternating control indicated by control sequence for each pump.

Terminal blocks with numbered and color-coded wiring to match wiring diagram.
Metal raceway for factory-installed wiring outside of enclosures. Make connections to motor with liquidtight conduit.
Removable control mounting plate.
Visual indication of on/off status and pump failure alarm.
Audible alarm and silence switch.
Visual indication of elapsed run time, graduated in hours.
Fusible, control-circuit transformer.
Microprocessor-based controller.

Transfer Pump Start-Stop Control Sequence: Deaerator water-level controller controls lead pump; alternator switches lead and lag pumps after each start to equalize run time; failure of lead pump switches to lag pump and sounds audible alarm.

Transfer Pump Continuous-Run Control Sequence: Lead pump runs continuously while deaerator is operating; deaerator water-level controller modulates water-level-control valve; lead and lag pumps switch to equalize run time; lag pump operates if lead pump fails; pump failure sounds audible alarm.

J. Building Management System Interface: Factory install hardware to enable building management system to monitor and display points.

1. Hardwired Monitoring Points: On/off status for each pump, failure alarm for each pump , low-water level alarm , high-water level alarm.

2.4 CAPACITIES AND CHARACTERISTICS:

A. See schedules on drawings.

2.5 FACTORY FINISHES

A. Manufacturer's standard paint in standard colors, applied to factory-assembled and - tested unit before shipping.

2.6 SOURCE QUALITY CONTROL

Fabricate and label deaerator tanks according to ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

Factory install and test piping that connects pumps to tanks according to ASME B31.1, "Power Piping."

C. Factory test performance and certify test results on packaged deaerator and surge tank units, according to ASME PTC 12.3, before shipping to Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before deaerator and surge tank installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance, maintenance, and operations.

Final deaerator and surge tank locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Install deaerator and surge tank packages level on concrete base. Concrete base is specified in Division 15 Section "Basic Mechanical Materials and Methods," and concrete materials and installation requirements are specified in Division 3.

Install deaerator and surge tank packages to permit access for service and maintenance.

Support piping independent of pumps.

Install all parts and materials not factory installed.

Extend overflow drains to trench drains.

Extend vent piping to outside and terminate with manufacturer-approved cap furnished with deaerator and surge tank.

G. Install piping adjacent to machine to allow service and maintenance.

3.3 CONNECTIONS

Steam and condensate piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

Connect steam and condensate piping to tank tappings with shutoff valves and unions or flanges at each connection.

C. Connect condensate drains, pump-discharge piping, vents, overflow drains, makeup water, steam supply, and cooling soft water piping.

3.4 FIELD QUALITY CONTROL

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections: By Contractor and Factory - Authorized Representative:

Inspect field-assembled components and equipment installation, including piping and electrical connections, for compliance with requirements.
Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
Verify bearing lubrication.
Verify proper motor rotation.

5. Test Reports: Prepare a written report to record the following:

Test procedures used.
Test results that comply with requirements.

c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning equipment and retest as specified above.

3.5 STARTUP SERVICE

Engage a factory-authorized service representative to perform startup service.

Complete installation and startup checks according to manufacturer's written instructions and do the following:

Set deaerator makeup water-level controls.
Verify bearing lubrication.
Verify proper motor rotation.
Start pumps according to manufacturer's written instructions.

3.6 ADJUSTING AND CLEANING

Adjust initial temperature and pressure set points.

Set field-adjustable switches and circuit-breaker trip ranges.

C. Clean strainers.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain deaerators.

END OF SECTION 235316

SECTION 235400 - FURNACES

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:

Gas-fired, condensing furnaces and accessories complete with controls.
Air filters.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each of the following:

Furnace.
Air filter.
3. Refrigeration components coils and condensing units.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For furnace to include in operation, and maintenance manuals for each of the following:

Furnace and accessories complete with controls.
Refrigeration components i.e. coils and condensing units.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

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.

Comply with NFPA 70.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of furnaces that fail in materials or workmanship within specified warranty period:

1. Warranty Period, Commencing on Date of Substantial Completion:

Furnace Heat Exchanger: 10 years.
Integrated Ignition and Blower Control Circuit Board: Five years.
Draft-Inducer Motor: Five years.
Refrigeration Compressors: 10 years.
e. Evaporator and Condenser Coils: Five years.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Disposable Air Filters: Furnish two complete sets.

PART 2 - PRODUCTS

2.1 GAS-FIRED FURNACES, CONDENSING

Provide the furnace, cooling coil as scheduled on the drawing.

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Trane model TUXIB040A9241A.
Carrier MVB or equal by.
York.
Prior approved equal.

General Requirements for Gas-Fired, Condensing Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21 .47/CSA 2.3, "Gas-Fired Central Furnaces," and with NFPA 54.

Cabinet: Steel.

Cabinet interior around heat exchanger shall be factory-installed insulation.
Lift-out panels shall expose burners and all other items requiring access for maintenance.
3. Factory paint external cabinets in manufacturer's standard color.

E. Fan: Centrifugal, factory balanced, resilient mounted, direct drive, variable speed.

Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.

Type of Gas: Natural.

AFUE: 90 percent.

Heat Exchanger:

1. Primary: Aluminized steel.

Burner:

Gas Valve: 100 percent safety two-stage main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.

Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.

J. Gas-Burner Safety Controls:

Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven; stops gas flow on ignition failure.
Flame Rollout Switch: Installed on burner box; prevents burner operation.

3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.

K. Combustion-Air Inducer: Centrifugal fan with thermally protected motor and sleeve bearings prepurges heat exchanger and vents combustion products; pressure switch prevents furnace operation if combustion-air inlet or flue outlet is blocked.

Furnace Controls: Solid-state board integrates ignition, heat, cooling, and fan speeds; adjustable fan-on and fan-off timing; terminals for connection to accessories.

Accessories:

Combination Combustion-Air Intake and Vent: PVC plastic fitting to combine combustion-air inlet and vent through outside wall or roof.
Plastic Vent Materials.

a. CPVC Plastic, Schedule 40 Pipe: ASTM F 441/F 441M.

CPVC Plastic, Schedule 40 Fittings: ASTM F 438, socket type.
CPVC Solvent Cement: ASTM F 493.

b. PVC Plastic, Schedule 40 Pipe: ASTM D 1785.

PVC Plastic, Schedule 40 Fittings: ASTM D 2466, socket type.
PVC Solvent Cement: ASTM D 2564.

N. Capacities and Characteristics: See drawings.

2.2 AIR FILTERS

A. Disposable Filters mounted in R.A duct: 1-inch- thick, disposable, fiberglass type in sheet metal frame.

2.3 REFRIGERATION COMPONENTS

Refrigerant Coil: Copper tubes mechanically expanded into aluminum fins. Comply with ARI 210/240, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment." Match size with furnace. Include condensate drain pan with accessible drain outlet.

1. Refrigerant Coil Enclosure: Steel, matching furnace and evaporator coil, with access panel and flanges for integral mounting at or on furnace cabinet and galvanized sheet metal drain pan coated with black asphaltic base paint.

Refrigerant Piping: Comply with requirements in Division 15 Section "Refrigerant Piping."

PART 3 - EXECUTION

3.1 EXAMINATION

Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

Examine factory-installed insulation before furnace installation. Reject units that are wet, moisture damaged, or mold damaged.

Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Install gas-fired furnace and associated fuel and vent features and systems according to NFPA 54.

Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.

1. Anchor furnace to substrate to resist code-required seismic acceleration.

C. Wiring Method: Install control wiring in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.

3.3 CONNECTIONS

Gas piping installation requirements are specified in Division 15 Section "Fuel Gas Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.

Install piping adjacent to equipment to allow service and maintenance.

C. Vent and Outside-Air Connection, Condensing, Gas-Fired Furnaces: Connect plastic piping vent material to furnace connections and extend outdoors. Terminate vent outdoors with a combination plastic combustion air intake and vent.

Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

3. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

c. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

4. Slope pipe vent back to furnace or to outside terminal.

D. Connect ducts to furnace with flexible connector. Comply with requirements in Division 15 Section "Duct Accessories."

E. Connect refrigerant piping to refrigerant coil in furnace and to air-cooled, compressor-condenser unit.

Flared Joints: Use ASME B16.26 fitting and flared ends, following procedures in CDA's "Copper Tube Handbook."

Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

3. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Comply with requirements in Division 15 Section "Refrigerant Piping" for installation and joint construction of refrigerant piping.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

Perform electrical test and visual and mechanical inspection.

Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.

Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.

Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

3.5 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

Inspect for physical damage to unit casings.

Verify that access doors move freely and are weathertight.

Clean units and inspect for construction debris.

Verify that all bolts and screws are tight.

Adjust vibration isolation and flexible connections.

Verify that controls are connected and operational.

B. Start unit according to manufacturer's written instructions and complete manufacturer's operational checklist.

C. Measure and record airflows.

Verify proper operation of capacity control device.

After startup and performance test, lubricate bearings.

3.6 ADJUSTING

Adjust initial temperature set points.

Set controls, burner, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

3.7 CLEANING

After completing installation, clean furnaces internally according to manufacturer's written instructions.

Install new filters in furnace within 14 days after Substantial Completion.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain condensing furnace and air cooled condensing units. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 235400

DIVISION 26: ELECTRICAL

26 0001 ELECTRICAL GENERAL PROVISIONS
26 0070 ELECTRICAL CONNECTIONS FOR EQUIPMENT
26 0072 ELECTRICAL SUPPORT & SEISMIC RESTRAINTS
26 0110 CONDUIT RACEWAYS
26 0120 CONDUCTORS & CABLES
26 0135 ELECTRICAL BOXES & FITTINGS
26 0140 WIRING DEVICES
26 0155 MOTOR STARTERS
26 0160 PANELBOARDS
26 0170 DISCONNECT SWITCHES
26 0180 OVERCURRENT PROTECTIVE DEVICES
26 0181 DRY-TYPE TRANSFORMERS
26 0182 PAD-MOUNTED TRANSFORMERS
26 0183 MOTOR CONTROL CENTERS
26 0184 POWER FACTOR CORRECTION
26 0289 TVSS SYSTEMS
26 0420 SERVICE ENTRANCE
26 0452 GROUNDING
26 0510 INTERIOR AND EXTERIOR BUILDING LIGHTING
26 0610 EMERGENCY ELECTRICAL SYSTEMS

DIVISION 27: ELECTRICAL

27 0740 TELEPHONE AND DATA SYSTEMS

DIVISION 28: ELECTRICAL

28 0721 DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

END OF TABLE OF CONTENTS

SECTION 260001 - 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 divisions 26, 27, and 28.

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:

Division 1 - General and Supplementary Conditions
Division 2 - Existing Conditions
Division 3 - Concrete
Division 5 - Metals
Division 6 - Wood, Plastics, and Composites
Division 7 - Thermal and Moisture Protection
Division 8 - Openings
Division 9 - Finishes
Division 21 - Fire Suppression
Division 22 - Plumbing
Division 23 - Heating Ventilating and Air Conditioning
Division 27 - Communications
Division 28 - Electronic Safety and Security

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 26, 27, and 28 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 first-class workmanship from competent workers, 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 Divisions 26, 27, and 28, 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 Divisions 26, 27, and 28.

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 describes 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. Written warranties and guarantees are to be submitted separately as:

1. Originals bound in a binder clearly identified with the title, “WARRANTIES AND GUARANTEES,” the project name, the project number, and the Contractor’s business name.

2. Electronic documents in *.pdf format.

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 Divisions 26, 27, and 28 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	$148.00 / Hr.
2.	Engineer	$ 92.00 / Hr.
3.	Designer	$ 74.00 / Hr.
4.	Construction Administrator	$ 86.00 / Hr.
5.	Drafting	$ 54.00 / Hr.
6.	Clerical	$ 45.00 / 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, both during the execution, and at the conclusion, of the project. 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.

F. Excavation Permits: Obtain all shut-down and excavation permits as may be required for proper completion of the work.

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. Motor control centers
4. Generators
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. Transformer Pads: Provide and locate properly sized concrete pads for pad mounted transformers in accordance with clearance requirements indicated on drawings.

3.14 TESTS:

A. Notify engineer prior to all testing specified herein at least three business days prior to testing. 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 260001

SECTION 260070 - 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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. Etc.

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 - 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 26, 27, and 28 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 260070

SECTION 260072 - 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. IBC: International Building Code.

B. 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. Raceway and Cable Supports: As described in NECA 1.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. 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.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. 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. 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.

C. 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 fasteners 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 260072

SECTION 260110 - 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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

1.3 QUALITY ASSURANCE:

A. Standards: Refer to Section 260001 - 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.

H. Electric Non-Metallic Tubing (ENT): Not Allowed.

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 specifically approved by the Electrical Engineer.

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. Coat all metal conduits with an approved asphaltic compound or wrap with two layers of PVC tape.

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 conduits before installing conductors.

END OF SECTION 260110

SECTION 260120 - 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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. Others not listed are not permitted.

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 260001 – 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.

2.3 FLEXIBLE CORDS:

A . Manufacturers:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.
5. Encore Wire.

B . Refer to Part 3 "Conductor and Cable Applications" Article for application requirements.

C . References and Ratings:

1. ASTM.
2. ICEA.
3. UL 62.
4. Pendant or portable.
5. Damp locations.
6. 600 Volts.
7. NEC Article 400.

D . Conductor Material: Copper.

E . Stranding: Class K, flexible stranded conductor.

F . Conductor Insulation Types: Heat- and moisture-resistant TPE insulation.

G . Fillers and Wrapping: Non-wicking polypropylene fillers, with tissue-paper separator wrapped around the assembly.

H . Outer Jacket: Black-colored, heat-, moisture-, and oil-resistant TPE jacket.

I . Grounding: Insulated green grounding conductor.

J . Cord Type: SO, hard-usage.

2.4 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.

C . Splices for wire sizes #10 and smaller shall be screw-on type similar to scotch or ideal wing nut connectors. Crimp-on splices designed to be used without wire stripping are not acceptable.

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.

3.3 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.
5. Color-code 277/480V system conductors:
   a) Phase A: Brown.
   b) Phase B: Orange.
   c) Phase C: Yellow.
   d) Neutral: White with colored stripe or gray.
   e) Ground: Green.

3.4 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).

3.5 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 shared common neutral is allowed.

3.6 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. 120V 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)
0-80	#12
81-125	#10
126-200	#8
201-320	#6

4. Use the NEC method to calculate voltage drop.

3.7 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.

3.8 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 260120

SECTION 260135 - 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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. Conduit Bodies
5. Bushings
6. Locknuts
7. Knockout Closures
8. Miscellaneous Boxes and Fittings

1.3 QUALITY ASSURANCE:

A . Standards: Refer to Section 260001 - 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 314.16(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 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.

2.5 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.

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 260135 – 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.

2.6 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.

2.7 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 260135

SECTION 260140 - 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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. Special Purpose Outlets
4. Cord Caps and Connectors
5. Occupancy Sensors

1.3 QUALITY ASSURANCE:

A . STANDARDS: Refer to Section 260001 - Electrical General Provisions as applicable.

B . SHOP DRAWINGS:

1. Submit manufacturer's data on all electrical wiring devices.
2. Where occupancy sensors are required, provide scaled drawing showing manufacturer’s recommended locations.

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. Provide red receptacle outlets and toggle switches where devices are circuited to emergency power. Provide orange receptacle outlets where devices are circuited to UPS power.

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
Cooper	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	GF5362	5362IG
Pass & Seymour	5362	2091-S	IG6300
Leviton	5362	8899	5362-IG
Cooper	5362	VGF20	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 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.

2.5 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. Cooper
5. Bryant

2.6 COVERPLATES:

A . Wall Plates: Provide coverplates for all wiring devices. In all finished areas, provide nylon or high impact resistant thermoplastic coverplates in colors as selected by Architect. Provide red coverplates for all receptacle outlets and toggle switches that are circuited to emergency power. 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

2.7 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 . Ceilings-Type Occupancy Sensors :

1. One-way Sensors: Pattern shall cover 900 sq. ft minimum of ½ step motion and 670 sq. ft minimum working-at-desk motion.
2. Two-way Sensors: Pattern shall cover 1,800 sq. ft. minimum of ½ step motion and 1,344 sq. ft minimum working-at-desk motion.
3. Corridor and Warehouse Sensors: Sensors shall detect motion in a corridor 14' wide and 80' long, with one sensor mounted 10' above the floor. Sensors shall detect motion in a warehouse aisle 10' wide and 60' long (walking motion) or 100' long (forklift motion) when mounted 22 feet above the floor.
4. Sensors shall contain timing circuiting to provide user adjustable "time to light off" delay of 30 seconds to 12 minutes.
5. A manual override switch in the sensor shall allow the load to be turned on without tools in the event of sensor failure.
6. Switchpack: Provide switchpack for 15 VDC power to sensors for relay switching of load. Relay contact shall be isolated and shall be operable on either 120 or 277 VAC circuits. Relay contacts shall have ratings as follows:
   a. 10A - 120 VAC Tungsten
   b. 20A - 120 VAC Ballast
   c. 20A - 277 VAC Ballast

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 circuits.

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 on the load side of GFCI receptacle - Install GFCI receptacles.

3.4 SURFACE RACEWAYS:

A. Provide all receptacles and special purpose outlets required in surface raceways. See Sections 260110 – Conduit Raceways, and 260135 – Electrical Boxes and Fittings.

3.5 OCCUPANCY SENSORS:

A. Do not locate immediately adjacent to air diffusers. Coordinate exact placement with Divisions 21, 22, and 23.

3.6 GROUNDING:

A. Provide electrical continuous, tight, grounding connections for wiring devices.

3.7 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.

3.8 IDENTIFICATION:

A. All devices shall be identified on the coverplate with panelboard name and circuit number.

B. In each outlet, tag each wire to identify the circuit it serves.

C. Identification labels shall be as follows:

Normal Power	Black with White letters
Emergency Power	Red with White Letters

END OF SECTION 260140

SECTION 260155 - 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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. Integral Horsepower Manual Starters
3. Non-Reversing Magnetic Starters
4. Two-Speed Non-Reversing Magnetic Starters
5. Combination Non-Reversing Magnetic Starters

1.3 QUALITY ASSURANCE:

A . STANDARDS: Refer to Section 260001 - 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 INTEGRAL HORSEPOWER MANUAL STARTERS:

A . Provide integral horsepower manuals starters for single-phase and three-phase motors in excess of 1 horsepower, equivalent to Square D Class 2510, Type M, 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, low voltage protection, red pilot light, and push button with mechanism lock off. Provide ANSI/NEMA ICS 6, Type 1 enclosures, or where subject to weather or moisture, Type 3R.

2.5 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 Divisions 21, 22, and 23). 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.

2.6 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 Divisions 21, 22, and 23.

2.7 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" and "TWO-SPEED 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.

C . Where Combination Magnetic Starter/Nonfusible Disconnect Switches are specified, provide NEMA KS 1, enclosed knife switch with externally operable handle and visible blades. Provide disconnects with externally operable handles that give positive visual indication of ON-OFF positions with red and black color coding.

D . Where Combination Magnetic Starter/Fusible Disconnect Switches are specified, provide NEMA KS 1, enclosed knife switch with externally operable handle and visible blades. Provide switches with Fuse clips to accommodate Class J fuses. Provide fuses in accordance with Section 260180 - Overcurrent Protective Devices. Provide disconnects 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 260155

SECTION 260160 – 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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 260001 - 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 spatial 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 260180 - 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 260180 - 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). 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 feed 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 unless 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 260160

SECTION 260170 - 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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
2. Fusible Switches

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 - 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 spatial 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 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. Cutler Hammer

2. General Electric
3. Siemens
4. 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 260180 - 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 260170

SECTION 260180 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.

1.4 SUBMITTALS FOR CONSTRUCTION

A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five(5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies of the short-circuit input and output data, where required, shall be provided on CD in PDF format.

B. For large system studies with more than 200 bus locations, the contractor is required to provide the study project files to the owner in electronic format. In addition, a copy of the computer analysis software viewer program is required to accompany the electronic project files, to allow the owner to review all aspects of the project and print arc flash labels, one-line diagrams, and other items.

C. The report shall include the following sections:

1. Executive summary
2. Descriptions, purpose, basis, and scope of the study
3. Tabulations of circuit breaker, fuse, and other protective device rating versus calculated short circuit duties
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection
5. Fault current calculations, including a definition of terms and guide for interpretation of the computer printout
6. Details of the incident energy and flash protection boundary calculations
7. Recommendations for system improvements, where needed
8. One-line diagram

D. Arc flash labels shall be provided in hard copy only.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. The equipment manufacturer or approved engineering firm shall demonstrate experience with arc flash hazard analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.

D. The contractor shall furnish an arc flash hazard analysis study, per the requirements set forth in NFPA 70E – Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

F. Comply with IEEE 399 for general study procedures.

G. Comply with 1584 – Guide for Performing Arc-Flash Hazard Calculations.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

1. CGI CYME.

2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:
   a. Arcing faults.
   b. Simultaneous faults.
   c. Explicit negative sequence.
   d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

   a. Circuit-breaker and fuse-current ratings and types.
   b. Relays and associated power and current transformer ratings and ratios.

c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
d. Generator kilovolt amperes, size, voltage, and source impedance.
e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
f. Busway ampacity and impedance.
g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

a. Special load considerations, including starting inrush currents and frequent starting and stopping.
b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
d. Generator thermal-damage curve.
e. Ratings, types, and settings of utility company's overcurrent protective devices.
f. Special overcurrent protective device settings or types stipulated by utility company.
g. Time-current-characteristic curves of devices indicated to be coordinated.
h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchgear and switchboard bus.
2. Medium-voltage controller.
3. Motor-control center.
4. Distribution panelboard.
5. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with [**IEEE 141**] [**IEEE 241**] and IEEE 242.

1. Transformers:

a. ANSI C57.12.10.
b. ANSI C57.12.22.
c. ANSI C57.12.40.
d. IEEE C57.12.00.
e. IEEE C57.96.

2. Medium-Voltage Circuit Breakers: IEEE C37.010.
3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-[**and high-**]voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with [**IEEE 141**] [**IEEE 241**] [**IEEE 242**] recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:
   a. Inrush current when first energized.
   b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
   c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
   a. Device tag.
   b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
   c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
   d. Fuse-current rating and type.
   e. Ground-fault relay-pickup and time-delay settings.
2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
   a. Device tag.
   b. Voltage and current ratio for curves.
   c. Three-phase and single-phase damage points for each transformer.
   d. No damage, melting, and clearing curves for fuses.
   e. Cable damage curves.
   f. Transformer inrush points.
   g. Maximum fault-current cutoff point.

G. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway, and splitters) where work could be performed on energized parts.

C. The arc flash hazard analysis shall include all significant locations to 240 volt and 209 volt systems fed from transformers equal to, or greater than, 125 kVA , where work could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary, considering an incident energy of 1.2 cal/cm^2.

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum mother contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into considering the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows.

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker, as required above, the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to computer the incident energy for the corresponding location.

K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds, based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

3.6 ARC FLASH WARNING LABELS

A. The contractor of the arc flash hazard analysis shall provide a 3.5 inch x 5 inch thermal transfer-type label of high adhesion polyester for each work location analyzed.

B. All labels will be based on recommended overcurrent device setting and will be provided after the results of the analysis have been presented to the owner, and after any system changes, upgrades, or modifications have been incorporated in the system.

C. The label shall included the following information, at a minimum:
1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Incident energy
6. Working distance

7. Engineering report number, revision number, and issue date

D. Labels shall be machine-printing, with no field markings.

E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
   1. For each 600, 480, and applicable 208 volt panelboard, one arc flash label shall be provided.
   2. For each motor control center, one arc flash label shall be provided.
   3. For each low-voltage switchboard, one arc flash label shall be provided.
   4. For each switchgear, on flash label shall be provided.
   5. For medium voltage switches, one arc flash label shall be provided.

F. Labels shall be field-installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.7 ARC FLASH TRAINING

A. The contractor of the arc flash hazard analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET), or equivalent.

END OF SECTION 260180

SECTION 260181 – DRY-TYPE TRANSFORMERS

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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to transformers.

1.2 DESCRIPTION OF WORK:

A. Extent of transformer work is indicated by drawings and schedules and is specified herein.

B. Type of transformers in this section include the following:

1. Dry-type transformers

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 - Electrical General Provisions as applicable.

B. SUBMITTALS:

1. SHOP DRAWINGS: Submit dimensioned drawings of transformers and enclosures showing accurately scaled layouts of enclosures. Provide product data including certification of transformer performance efficiency, percent regulation at 100 percent and 80 percent power factor, no-load and full load losses in watts, percent impedance at 75 degree C broken down into resistance and reactance, hot-spot and average temperature rise above 40 degree C ambient, sound level in decibels, and standard published data.
2. EQUIPMENT ROOM LAYOUTS: Submit dimensioned drawings of all equipment rooms indicating spatial 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
2. General Electric
3. Siemens
4. Square D
5. Federal Pacific Transformers Co.
6. Cooper Power Systems
7. Powersmiths

2.2 GENERAL:

A. Provide transformers, enclosures, and ancillary components, of types, sizes, and ratings indicated.

2.3 DRY-TYPE TRANSFORMERS:

A. Taps: Provide primary windings with minimum of 4 full capacity taps; each 2-1/2 percent, two above and two below full-rated voltage for de-energized tap-changing operation.

B. Windings: All windings to be copper.

C. Insulation: Insulate with Class 220 insulation and rate for continuous operation at KVA.

D. Temperature Rise: Limit temperature rise to 150 degree C.

E. Sound Levels: Sound level rating not to exceed 45 db in accordance with ANSI/NEMA standards.

F. Efficiency: All transformers 15 KVA and larger shall meet the NEMA TP-1-2002 standard for energy efficiency.

G. Enclosure: Provide ventilated, heavy-gauge, steel, painted enclosure.

H. Electrostatic shield: Where indicated on drawings, provide shielded isolation type transformers for attenuation of source line interference.

I. K-Factor Ratings: Where noted on drawings, provide K-factor rated transformers to serve harmonic loads equivalent to Square D NL (UL K-4 rated) or Square D NLP (UL K-13 rated) as indicated.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install transformers 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. Unless noted otherwise, mount transformers on 4" concrete house-keeping pad. Concrete pad to be furnished and installed under division 26. Anchor transformer enclosures firmly to concrete pad. See Section 260072 – Electrical Support and Seismic Restraints. Maintain adequate clearance from combustible surfaces in accordance with the NEC. Locate transformers a sufficient distance from walls and adjacent equipment to allow for adequate ventilation in accordance with all manufacturer's instructions. Lay-out electrical rooms and spaces prior to rough-in to insure proper ventilation and to maintain code required clearances.

3.3 LABELS:

A. For transformers, provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.

B. Provide red plastic laminate label for emergency loads.

END OF SECTION 260181

SECTION 260182 – PAD-MOUNTED TRANSFORMERS

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 26 General Provisions section, and is part of each Division 26, 27, or 28 section making reference to transformers.

1.2 DESCRIPTION OF WORK:

A. Extent of transformer work is indicated by drawings and schedules and is specified herein.

B. Type of transformers in this section include the following:

1. Three-Phase Compartmental Type Pad-Mounted Transformers

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 - Electrical General Provisions as applicable.

B. SUBMITTALS:

1. SHOP DRAWINGS: Submit dimensioned drawings of transformers and enclosures showing accurately scaled layouts of enclosures. Provide product data including certification of transformer performance efficiency, percent regulation at 100 percent and 80 percent power factor, no-load and full load losses in watts, percent impedance at 75 degree C broken down into resistance and reactance, hot-spot and average temperature rise above 40 degree C ambient, sound level in decibels, and standard published data.
2. EQUIPMENT ROOM LAYOUTS: Submit dimensioned drawings of all equipment rooms indicating spatial 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
2. General Electric
3. Siemens
4. Square D
5. Federal Pacific Transformers Co.
6. Cooper Power Systems

2.2 GENERAL:

A. Provide transformers, enclosures, and ancillary components, of types, sizes, and ratings indicated.

2.3 THREE-PHASE COMPARTMENTAL TYPE PAD-MOUNTED TRANSFORMERS:

A. Ratings:

1. KVA: 750
2. Phase: Three
3. Frequency: 60 Hz
4. Primary Voltage: 12,470 V Delta (95 BIL)
5. Taps: Two each 2 1/2% Taps Above and Below Normal
6. Secondary Voltage: 277/480 V Wye (95 BIL)
7. Impedance: 5.75%
8. Temperature Rise: 65 Degree above a 30 Degree average ambient with a maximum ambient not to exceed 40 Degree C.
9. Coolant: (Insulating Oil) (RTEmp high firepoint, non-propagating dielectric coolant). Non-PCB per E.P.A. Definition 7/1/79.

B. Standards:

1. The transformers shall comply with the latest applicable standards of the NEMA and ANSI.

C. Construction:

1. The transformers shall be compartmental type, self-cooled, tamper resistant and weather protected for mounting on a pad. There shall be no exposed screws, bolts, or other fastening devices with are externally removable.
2. The transformers shall be of the sealed tank construction of sufficient strength to withstand a pressure of 7 psi without permanent distortion. The cover shall be bolted on and the fastenings tamper resistant. The transformer will remain effectively sealed for a top oil temperature range of 50 Degree C. to 106 Degrees C. When required, corrugate cooling panels or radiators will be provided on the back and side of the tanks. Lifting eyes and jacking pads will be provided.
3. A tap changing mechanism shall be provided for accurate voltage adjustments without opening the transformer tank. The tap changing mechanism shall be externally operated and shall be for de-energized operations.
4. The high and low voltage compartments shall be located side-by-side separated by a steel barrier. When facing the transformer, the low voltage compartment shall be on the right. Terminal compartments shall be full height, air filled with individual doors. The high voltage door fastenings shall not be accessible until the low voltage door has been opened. The low voltage door shall have a 3-point latching mechanism with a cabinet handle having provisions for a single padlock. The doors shall be equipped with lift-off type stainless steel hinges and door stops to hold the doors open when working in the compartments. The front sill of the compartment shall be removable to allow the transformer to be rolled or skidded into position over conduit stubs. ANSI tank grounding provisions shall be furnished in each compartment.

D. High Voltage Terminations and Equipment:

1. The high voltage terminations and equipment shall be
   a. The terminations and equipment shall be arranged for (radial) (loop) feed.

E. High Voltage Switching and Protective Equipment:

1. For oil immersed switches select for either radial (1) or loop feed (2):
   a. Provide OFF-ON load-break, gang operated, oil immersed switch. Switch handle with eye for operation with distribution hot stick shall be located in the high voltage compartment.
   b. Provide four position load-break, gang operated, oil immersed switch. Switch handle with eye for operation with distribution hot stick shall be located in the high voltage compartment and shall have indexing plate to prevent switching beyond one position per operation.
2. For oil immersed fused select one only:
   a. Provide internal oil immersed cartridge fuses sized at approximately 3.0 times primary current.
   b. Provide Bay-O-Net type oil immersed fuses.
   c. Provide Bay-O-Net type oil immersed fuses in series with oil immersed current limiters.
   d. Provide Bay-O-Net type current limiting fuses.
3. Surge Arresters:
   a. Dead-front: Provide 3 __ KV elbow valve arrester for placement in the high voltage compartment.
   b. Dead-front: Provide 3 __ KV M.O.V.E. dead-front metal oxide varistor elbow arresters for placement in the high voltage compartment.

F. Low Voltage Terminations and Equipment:

1. The low voltage bushings shall be molded epoxy and provided with blade type spade terminals with NEMA standard hole spacings arranged for vertical take-off. The low voltage neutral shall be an insulated bushing grounded to the transformer tank via a removable grounding strap. Wye-Wye connect transformer shall have the high and low voltage neutrals internally tied with a removable link for testing.

G. Accessories:

1. The following accessories are standard:
   a. Nameplate in low voltage compartment.
   b. One-inch drain plug.
   c. One-inch upper filter press and filling plug.
   d. Liquid level indication (pipe plug at 35 Degree C. oil level).
2. The following accessories are optional:
   a. Dial type thermometer.
   b. Liquid level gauge.
   c. Pressure-vacuum gauge.
   d. Pressure relief valve.
   e. Pressure relief device (self resealing with indicator).
   f. Mounting provision for low voltage current transformers and potential transformers.
   g. Two position switch for radial feed.

H. Finish:

1. Painted Federal Paint Number 23517 (Greystone) or 30099 (Dakota Brown).

PART 3 - EXECUTION

3.1 GENERAL:

A. Install transformers 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. Unless noted otherwise, mount transformers on 4" concrete house-keeping pad. Concrete pad to be furnished and installed under division 26. Anchor transformer enclosures firmly to concrete pad. See Section 260072 – Electrical Support and Seismic Restraints. Maintain adequate clearance from combustible surfaces in accordance with the NEC. Locate transformers a sufficient distance from walls and adjacent equipment to allow for adequate ventilation in accordance with all manufacturer's instructions. Lay-out electrical rooms and spaces prior to rough-in to insure proper ventilation and to maintain code required clearances.

END OF SECTION 260182

SECTION 260183 - MOTOR CONTROL CENTERS

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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to Motor Control Centers.

1.2 DESCRIPTION OF WORK:

A. Extent of motor control center work is indicated by drawings and schedules and is specified herein.

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 - Electrical General Provisions as applicable.

B. SUBMITTALS:

1. Shop Drawings: Submit dimensioned drawings of motor control centers and enclosures showing accurately scaled layouts of enclosures. Include schedule of devices, including, but not necessarily limited to, motor starters, circuit breakers, and accessories.
2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial 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
2. General Electric
3. Siemens
4. Square D

2.2 GENERAL:

A. Provide motor control centers, enclosures, and ancillary components, of types, sizes, and ratings indicated. Provide motor starters, overcurrent protective devices, power factor correction capacitors, etc. as indicated on drawings for a complete installation. See Section 260155 - Motor Starters, Section 260180 - Overcurrent Protective Devices, and Section 260184 - Power Factor Correction.

B. Power control circuits from individual starter or breaker switch such that opening switch or breaker de-energizes control circuit. Provide individual fusing for all control circuits. Lugs shall be rated copper only .

C. Rate devices, 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.

2.3 MOTOR CONTROL CENTER ENCLOSURES:

A. Provide factory assembled, front accessible, free-standing enclosures in NEMA types to suit respective applications. Standard sections shall have a top horizontal wire trough with an opening between sections. Provide ANSI-61 painted finish.

2.4 BUSSING SYSTEM:

A. Construct bus bars of silver-plated copper braced to withstand RMS symmetrical fault current indicated. Provide ground bus in each section.

2.5 DISCONNECT OPERATORS:

A. Provide external operator handles for switches and circuit breakers capable of being locked in the OFF position.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install motor control centers 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 exterior of each enclosure indicating name of motor control center. Bolt labels to enclosure. Mark on enclosure the source of power by indicating the panel and circuit number.

B. Provide red plastic laminate label for emergency loads.

3.3 MOUNTING:

A. Housekeeping Pad: Provide 4" high concrete pad. Mount motor control centers as indicated, but in no case higher than 6'-6" from finished floor to top of motor control center including concrete pad. Bolt motor control centers to concrete pad in accordance with Section 260072 – Electrical Support and Seismic Restraints.

3.4 CIRCUIT DIRECTORIES:

A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.

B. Provide red plastic laminate label for emergency loads.

3.5 WIRING METHODS:

A. Arrange conductors neatly within enclosure, and secure with suitable nylon ties.

END OF SECTION 260183

SECTION 260184 - POWER FACTOR CORRECTION

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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to power factor correction.

1.2 DESCRIPTION OF WORK:

A. Extent of power factor correction is indicated by drawings and schedules and is specified herein.

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 - Electrical General Provisions as applicable.

1.4 SUBMITTALS:

A. Shop Drawings: Submit dimensioned drawings of power factor correction equipment and enclosures showing accurately scaled layouts of enclosures and all components. Submit manufacturer's data on all equipment.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with all requirements, provide products from one of the follows:

1. Cutler-Hammer
2. General Electric
3. Siemens
4. Square D

2.2 GENERAL:

A. Provide power factor correction equipment and ancillary components in sizes and characteristics to suit respective applications and as indicated on drawings.

2.3 CAPACITORS:

A. Provide factory-assembled power factor correction capacitors in types, sizes, ratings, and electrical characteristics indicated. Provide industrial-grade capacitors with metal encased dielectric systems possessing self-clearing characteristics. Provide capacitors with discharge resistors to drop residual voltage to 50 Volts, or less, within one minute after the cell is disconnected from power source. Provide capacitors cell capable of operating in an ambient temperature range of -40 Degrees C. to 50 Degree C. and capable of operating at 135% of their rated capacitive reactive power due to the combined effects of frequency variation, overvoltages

and/or harmonics. Provide current limiting protective fusing and blown fuse indicators. Rate enclosures to suit respective application.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install Power factor correction equipment 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. Mount capacitors in motor control centers or adjacent to motors as indicated. Provide all necessary connectors, frames, racks, etc. necessary for a complete system. See Section 260072 – Electrical Support and Seismic Restraints as applicable.

END OF SECTION 260184

SECTION 260289 - 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 26 Section "Switchboards" 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 26 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, non-condensing.
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 26 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. EFI Electronics
4. General Electric Company.
5. LEA International.
6. Leviton Mfg. Company Inc.
7. Liebert Corporation; a division of Emerson.
8. Siemens Energy & Automation, Inc.
9. Square D; Schneider Electric.
10. 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. Power Distribution Panelboard, Motor Control Center, and Switchboard 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 supersede 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 supersede 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.
2. NEMA 12 dust-tight enclosures intended for indoor use primarily to provide protection against circulating dust, falling dirt and dripping non-corrosive liquids. (Panelboards Only)
3. NEMA 4 watertight stainless steel intended for indoor or outdoor use primarily to provide protection against windblown dust and rain, splashing rain, hose-directed water, and damage from external ice formation. (Side Mounted Unites Only)

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 260289

SECTION 260420 - 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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. CT Enclosures
3. Metering
4. Service Entrance Switchboards and/or Panelboards
5. Overcurrent Protective Devices and/or disconnects

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 - 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 RACEWAYS AND CONDUCTORS:

A. Provide service entrance raceways and conductors in accordance with Section 260110 - Conduit Raceways, and Section 260120 - Conductors and Cables.

2.3 CT ENCLOSURES:

A. Provide CT enclosures complete with meter bases of types and sizes in accordance with all

owner requirements. Provide steel reinforced, concrete pads with openings in accordance with same. Refer to "Concrete Bases" under Section 260001 - Electrical General Provisions. Verify and comply with all power company requirements prior to installation.

2.4 METERING:

A. Meter Bases: Provide meter bases in accordance with all power company requirements. Extend 1" empty conduit from meter bases to secondary compartment of power company transformer. Verify exact location of meter bases prior to installations.

1. Meters:
   a. Subject to compliance with all requirements, provide metering equipment from one of the following:

      1) General Electric
      2) Siemens
      3) Square D
      4) Cutler Hammer

B. Power Meters:
1. Provide Square D Power Logic Circuit Monitor, Class 3020, Model CM-3250, 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:
      1) Six-digit LED display
      2) Kilo/Mega units LEDs
      3) Meter indication LEDs
      4) Setup/rest parameters
      5) Phase indication LEDs
      6) Phase select button
      7) Select meter buttons
      8) Mode indication LEDs
      9) Mode select button
      10) 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:
      1) Current (per phase, N, G, 3 phase)
      2) Voltage, per phase (L-L, L-N), and 3 phase average.
      3) Apparent RMS Current
      4) Real power (per phase, 3 phase)
      5) Reactive Power (per phase, 3 phase)

6) Apparent power (per phase, 3 phase)
7) Power factor (per phase, 3 phase)
8) Frequency
9) THD (current and voltage)
10) K-factor (per phase)

b. Demand Readings:
1) Demand current (per-phase present, peak)
2) Average demand current (per phase present, peak)
3) Peak demand current (per phase)
4) Average power factor (3 phase total)
5) Demand real power (3 phase total)
6) Average demand peak power (3 phase total)
7) Predicted demand real power
8) Peak demand real power
9) Demand apparent power (3 phase total)

c. Energy Readings:
1) Accumulated energy, real
2) Accumulated energy, reactive

d. Power Analysis Values:
1) Crest factor (per phase)
2) K-factor demand (per phase)
3) Displacement power factor (per phase, 3 phase)
4) Fundamental voltages (per phase)
5) Fundamental currents (per phase)
6) Fundamental real power (per phase)
7) Harmonic power
8) Unbalance (current and voltage)

4. Phase rotation

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 260180 - Overcurrent Protective Devices, and Section 260170 - 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 of concrete pad with local power company prior to installation. Strictly maintain sufficient distances from door, window, building walls and overhangs, gas meters, fuel tanks, etc. in accordance with all power company requirements. Field-verify placement of transformer pad in company with the local power company representative.

3.3 COORDINATION:

A. Coordinate all service entrance work with other trades.

B. Power Coordination: Coordinate installation of service entrance equipment with the owner to insure that power to building is ready when needed.

END OF SECTION 260420

SECTION 260452 – 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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 260001 - 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 fasteners (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 250-16 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 260452

SECTION 260510 - 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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. High Intensity Discharge (HID)

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 - 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 26.

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.
   d. Instant Start Electronic Ballasts: Electronic ballasts shall be instant start for maximum system efficacy. Ballast factor shall be 0.9, unless specified otherwise. Ballasts shall be parallel wired so that in the event of a lamp failure, the other lamps will continue to operate. Electronic ballasts shall provide for a minimum lamp starting temperature of 0 Degrees F.
   e. End-of-Life Circuitry: Ballasts for lamps of T5 and smaller including T5, T4, and T2 diameter shall contain end-of-life sensing circuitry to prevent lamp bulb, lamp base, or socket damage at lamp end-of-life.
2. Ballast Disconnect:
   a. Fluorescent fixtures that can be serviced-in-place shall come equipped with a disconnecting means that allows the ballast to be disconnected simultaneously from all conductors during maintenance and repair. The means of disconnect shall be placed so that it is accessible to all individuals before service of the fixture or ballast is initiated.
   b. The line-side terminals of the ballast disconnect shall also be guarded.
   c. The ballast disconnect shall adhere to the requirements outlined in the code, NEC 2005 410.73(G).
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 260510

SECTION 260610 - 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 26 General Provisions section, and is part of each Division 26, 27, and 28 sections 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 260001 - 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
4. Smith Detroit Diesel

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 48 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. When transfer switch is fed from an upstream overcurrent protection device having ground fault protection, provide a four pole unit with switched neutral.

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 warm-up, engine warm-up 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 260001 - 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 260001 - 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 judgment 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 260610

SECTION 270740 - TELEPHONE AND DATA 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 27 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to telephone and data systems.

1.2 DESCRIPTION OF WORK:

A. Extent of telephone and data systems is indicated by drawings and schedules and is specified herein. Telephone and data systems includes the following:

1. Telephone/data terminal backboards
2. Outlet Boxes and Raceways
3. Grounding

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 - Electrical General Provisions as applicable.

1.4 SHOP DRAWINGS: Not required.

PART 2 – PRODUCTS

2.1 TELEPHONE/DATA TERMINAL BACKBOARDS:

A. Provide 4'W x 8'H x 3/4"D, fire-treated or hypalon-coated plywood terminal backboard. Finish with insulating varnish.

2.2 OUTLET BOXES AND RACEWAYS:

A. Provide outlet boxes and raceways in accordance with the following sections.

1. Section 260110 - Conduit Raceways.
2. Section 260135 - Electrical Boxes & Fittings
3. Section 260072 – Electrical Support and Seismic Restraints

2.3 GROUNDING:

A. Provide grounding conductors and accessories in accordance with the following sections:

1. Section 260120 - Conductors and Cables
2. Section 260452 - Grounding.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install telephone/data 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 RACEWAYS:

A. Unless otherwise noted, extend 3/4" conduit from each telephone/data outlet to telephone terminal backboard, cabinet, or cable tray.

B. Minimum trade size is 3/4". Install a 200 lb. polypropylene pull cord in each empty conduit run.

C. Where raceway systems only are specified, provide blank coverplates for all unused telephone and data outlets.

3.3 GROUNDING:

A. Extend one #6 bare copper ground conductor from each telephone terminal board and/or cabinet to the service entrance ground bus. Coil 6' of conductor at each terminal backboard and/or cabinet.

END OF SECTION 270740

SECTION 280721 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

B. System shall be UL-listed and factory mutual-approved.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.

2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified fire-alarm technician, Level III minimum.
    c. Licensed or certified by authorities having jurisdiction.

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

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Qualification Data: For qualified Installer.

E. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field quality-control reports.

G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

    a. Frequency of testing of installed components.

b. Frequency of inspection of installed components.
c. Requirements and recommendations related to results of maintenance.
d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

H. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

I. The disks containing fire alarm files shall be supplied to the owner. These disks shall include all information required to allow the owner to change the fire alarm program themselves. These computer disks shall contain a minimum of the following:

1. CAD drawing files of the building fire alarm map.
2. CAD drawing files of as-build fire alarm component and point-to-point connections.
3. General configuration programming.
4. Job-specific configuration programming.
5. Tutorial file on complete programming of the fire alarm system.

J. The system contractor/supplier shall provide a “Certificate of Compliance” to the Authority Having Jurisdiction in accordance with NFPA Pamphlet 72B (1986 Edition), Section 2-2.6, at the completion of operational acceptance tests, as required herein. This will be applicable to all types of fire alarm systems.

K. A complete set of CAD “as-built” drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of equipment shall be delivered to the owner upon completion of the system installation.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project. Installation shall be by personnel certified by NICET as fire-alarm Level II technician

B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

1.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers / Installers: Subject to compliance with requirements, provide products by one of the following:

Manufacturer	Installer / Telephone
Silent Knight	**Automated Fire & Service / (801) 870-6282**
Harrington	**Automated Fire & Service / (801) 870-6282**

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
5. Activate emergency shutoffs for gas and fuel supplies.
6. Record events in the system memory.

C. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

D. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

    a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
    b. Include a real-time clock for time annotation of events on the event recorder and printer.

2. Addressable initiation devices that communicate device identity and status.

    a. Smoke sensors shall additionally communicate sensitivity setting.
    b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two (2) lines of forty (40) characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.

a. Initiating Device Circuits: Style D.
b. Notification Appliance Circuits: Style Z.
c. Signaling Line Circuits: Style 6.
d. Install no more than 100 addressable devices on each signaling line circuit.

D. Notification Appliance Circuit: Operation shall sound in Temporal Pattern 3.

E. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

F. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

G. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed, valve-regulated, recombinant lead acid.
2. Capacity: Size for all finished and unfinished spaces within building plus twenty-five (25) percent ampere-hour capacity.

H. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key-operated switch.

3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:
1. Detectors shall be two-wire type.
2. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
4. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
5. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

   a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
   b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
   c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

3. This is the default detector type to be used on the product, unless specifically indicated otherwise.

2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, as indicated in drawings, or
b. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, white.

2.8 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report

telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Zone of the supervisory signal.
3. Zone of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.9 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Power for the panel, battery charger, or any other device which affects the operation of the system shall be controlled through a single circuit breaker labeled, “Fire Alarm System – Do Not Turn Off.” Connect to engine generator-supported emergency circuit where available.

C. Equipment Mounting: Install wall-mounted fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
2. Locate fire alarm control unit as directed by the authority having jurisdiction.

D. Raceway: Install fire alarm conductors in raceway. Fire alarm system conductors from different zones may be combined in common conduit. Make certain that raceway and wire quantity, size, and type are 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 system.

E. Loop wires through each device in zone for proper supervision. Tee-taps are 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 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 the manufacturer.

I. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control equipment as necessary to extend existing control functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

J. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
5. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

K. Audible Alarm-Indicating Devices: Install at +80 inches (2032 mm) above finished floor, but not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn at +80 inches (2032 mm) above finished floor, but at least 6 inches (150 mm) below the ceiling.

M. Device Location-Indicating Lights: Locate in public space near the device they monitor.

N. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

O. Do not install manual fire alarm boxes close to light switches.

P. Manual alarm initiating stations shall be provided at all required building exits, boiler rooms, kitchens, and main administrative offices, and elsewhere to provide a maximum 200' travel distance to a pull station from any point in the building.

Q. Post copy of wire identification list inside fire alarm panel door and other area accessible to fire alarm service personnel.

R. The control and other panels shall be mounted with sufficient clearance for observation and testing.

S. All fire alarm junction boxes shall be identified with zone number and red paint for easy identification.

T. Mount remote multi-signialing accessory for non-system duct smoke detector in a readily accessible location and wire complete.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

C. All fire detection devices shall be marked in nominal ½" high letters with the zone and device number (for example: a mark reading, "1-20," indicated Zone 1, Device Number 20).

D. Building Fire Map:

1. A building fire alarm map shall be supplied to the owner, indicating the exact location and address of all 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. The 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.

3.3 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.4 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by Engineer and authorities having jurisdiction .

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions and Authority Having Jurisdiction. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions and Authority Having Jurisdiction.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions and Authority Having Jursidiction.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 280721

DIVISION 31: EARTHWORK

31 0000 EARTHWORK

31 0501 COMMON EARTHWORK REQUIREMENTS

31 1000 SITE CLEARING

31 1100 CLEARING AND GRUBBING
31 1413 TOPSOIL STRIPPING AND STOCKPILING

31 2000 EARTH MOVING

31 2213 ROUGH GRADING
31 2216 FINE GRADING
31 2316 EXCAVATION
31 2323 FILL
31 2324 GRANULAR BASE
31 2500 EROSION & SEDIMENTATION CONTROLS

SECTION 31 0501*

COMMON EARTHWORK REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited to:
   1. General procedures and requirements for earthwork.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification Of Conditions:
   1. 48 hours minimum before performing any work on site, contact Bluestakes to arrange for utility location services.
   2. Perform minor, investigative excavations to verify location of various existing underground facilities at sufficient locations to assure that no conflict with the proposed work exists and sufficient clearance is available to avoid damage to existing facilities.
   3. Perform investigative excavating 10 days minimum in advance of performing any excavation or underground work.
   4. Upon discovery of conflicts or problems with existing facilities, notify Architect by phone or fax within 24 hours. Follow telephone or fax notification with letter and diagrams indicating conflict or problem and sufficient measurements and details to evaluate problem.

3.2 PREPARATION

A. Protection:
   1. Spillage:
      a. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways.
      b. Remove spillage and sweep, wash, or otherwise clean project, streets, and highways.
   2. Dust Control:
      a. Take precautions necessary to prevent dust nuisance, both on-site and adjacent to public and private properties.
      b. Correct or repair damage caused by dust.
   3. Existing Plants And Features: Do not damage tops, trunks, and roots of existing trees and shrubs on site that are intended to remain. Do not use heavy equipment within branch spread. Interfering branches may be removed only with permission of Architect. Do not damage other plants and features that are to remain.

B. If specified precautions are not taken or corrections and repairs not made promptly, Owner may take such steps as may be deemed necessary and deduct costs of such from monies due to Contractor. Such action or lack of action on Owner's part does not relieve Contractor from responsibility for proper protection of The Work.

3.3 REPAIR / RESTORATION

A. Adjust existing covers, boxes, and vaults to grade.

B. Replace broken or damaged covers, boxes, and vaults.

C. Independently confirm size, location, and number of covers, boxes, and vaults that require adjustment.

3.4 FIELD QUALITY CONTROL

A. Field Inspections:
1. Notify Architect 48 hours before performing excavation or fill work.
2. If weather, scheduling, or any other circumstance has interrupted work, notify Architect 24 hours minimum before intended resumption of grading or compacting.

B. Field Tests: Owner reserves right to require additional testing to re-affirm suitability of completed work including compacted soils that have been exposed to adverse weather conditions.

END OF SECTION

SECTION 31 1100

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Perform clearing and grubbing as necessary to prepare site for rough grading and structure excavation as described in Contract Documents.

B. Related Requirements:
1. Section 31 0501: Common Earthwork Requirements.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Tree And Brush Removal:
1. Cut off trees, shrubs, brush, and vegetative growth 12 inches 300 mm maximum above ground.
2. Do not pull up or rip out roots of trees and shrubs that are to remain. If excavation through roots is required, excavate by hand and cut roots with sharp axe. Make clean, smooth, sloping cuts.
3. Cut roots 6 inches 150 mm or larger in diameter only with Architect's written permission.

B. Grubbing:
1. Grub out stumps and roots 12 inches 300 mm minimum below original ground surface, except as follows:
   a. Under buildings, remove roots one inch and larger entirely.
   b. Entirely remove roots of plants that normally sprout from roots, as identified by Architect.

3.2 CLEANING

A. Remove from site trees, shrubs, uprooted stumps, vegetative layer, and surface debris and dispose of legally.

B. Do not bury cuttings, stumps, roots, and other vegetative matter or burnt waste material on site.

END OF SECTION

Section 31 1413

TOPSOIL STRIPPING AND STOCKPILING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Strip and stockpile acceptable topsoil as described in Contract Documents.

B. Related Requirements:
   1. Section 31 0501: Common Earthwork Requirements.
   2. Section 32 9113: Finish grading of existing topsoil stored on site and addition of imported topsoil.

1.2 REFERENCES

A. Definitions: Existing topsoil is defined as total amount of soil stripped and stored for reuse, less vegetation layer stripped and disposed of as specified in Paragraphs below.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Strip existing vegetation layer 12 inches mm deep minimum from areas of site to receive buildings, landscaping, and paving and remove from site before stripping topsoil for storage and reuse.

B. After stripping vegetation layer, strip existing topsoil additional 12 inches mm deep minimum from areas of site to receive paving and store on site for later use.
   1. Existing topsoil is property of Contractor with restriction that topsoil is to be used first for Project landscape topsoil requirements and second for non-structural fill and backfill.
   2. After Project fill, backfill, and landscape topsoil requirements are satisfied, remove excess existing topsoil from site. Do not remove existing topsoil from site without Architect's written approval.

END OF SECTION

SECTION 31 2213

ROUGH GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Perform rough grading work required to prepare site for construction as described in Contract Documents.

B. Related Requirements:
1. Section 31 0501: Common Earthwork Requirements

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
1. Schedule conference after completion of site clearing but before beginning grading work.
2. Identify benchmark to be used in establishing grades and review Contract Document requirements for grades, fill materials, and topsoil.
3. Examine site to pre-plan procedures for making cuts, placing fills, and other necessary work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials used for fill shall be as specified for backfill in Section 31 2323.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Tolerances: Maximum variation from required grades shall be 1/10 of one foot 28 mm.

B. When existing grade around existing plants to remain is higher than new finish grade, perform regrading by hand. Do not expose or damage shrub or tree roots.

C. Compact fills as specified in Section 31 2323.

D. If soft spots, water, or other unusual and unforeseen conditions affecting grading requirements are encountered, stop work and notify Architect.

END OF SECTION

SECTION 31 2216

FINE GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Perform fine grading work required to prepare site for paving finish grading and for landscape finish grading and soil preparation as described in Contract Documents.

B. Related Requirements:
1. Section 31 0501: Common Site Construction Requirements.
2. Section 31 1413: Stripping and storing of existing topsoil.
3. Section 32 1216: Finish grading for asphalt paving.
4. Section 32 1313: Finish grading for concrete paving.
5. Section 32 9113: Soil preparation for landscaping.
6. Section 32 9120: Topsoil Placement and grading

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 31 2213.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection: Protect utilities and site elements from damage.

B. Surface Preparation:
1. Before grading, dig out weeds from planting areas by their roots and remove from site. Remove rocks larger than 1-1/2 inches 38 mm in size and foreign matter such as building rubble, wire, cans, sticks, concrete, etc.
2. Remove imported paving base material present in planting areas down to natural subgrade or other material acceptable to Architect.
3. Limit use of heavy equipment to areas no closer than 6 feet 1800 mm from building or other permanent structures

3.2 PERFORMANCE

A. Interface With Other Work: Do not commence work of this Section until grading tolerances specified in Section 31 2213 are met.

B. Site Tolerances:
1. Maximum variation from required grades shall be 1/10 of one foot 28 mm.
2. To allow for final finish grades of parking lot and planting areas, fine grade elevations before placing topsoil are:

a. Sod Areas: 7 inches 175 mmbelow top of walk or curb.
b. Seeded Areas And Ground Cover Areas: 6 inches 150 mm below top of walk or curb.
c. Tree And Shrub Areas: 4 inches 100 mm below top of walk or curb. No topsoil as defined in Section 32 9120 required.

C. Do not expose or damage existing shrub or tree roots.

D. Redistribute approved existing topsoil stored on site as a result of work of Section 31 1413. Remove organic material, rocks and clods greater than 1-1/2 inch 38 mm in any dimension, and other objectionable materials.

E. Slope grade away from building for 12 feet 3600 mm minimum from walls at slope of 1/2 inch in 12 inches 13 mm in 300 mm minimum unless otherwise noted. Direct surface drainage in manner indicated on Drawings by molding surface to facilitate natural run-off of water. Fill low spots and pockets with specified fill material and grade to drain properly.

END OF SECTION

SECTION 31 2316

EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Perform Project excavating and trenching as described in Contract Documents, except as specified below.
2. Procedure and quality for excavating and trenching performed on Project under other Sections unless specifically specified otherwise.

B. Related Requirements:
1. Section 31 0501: Common Earthwork Requirements.
2. Section 31 1100: Clearing and Grubbing.
3. Performance of excavating outside of building required for electrical work is responsibility of respective Section doing work unless arranged differently by Contractor.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 31 2213.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Carefully examine site and available information to determine type soil to be encountered. Discuss problems with Architect before proceeding with work.

3.2 PREPARATION

A. Protection of Existing Utilities:
1. Protect existing utilities identified in Contract Documents during excavation.
2. If existing utility lines not identified in Contract Documents are encountered, contact Architect before proceeding.

3.3 PERFORMANCE

A. Excavation:
1. Pavement And Miscellaneous Cast-In-Place Concrete:
   a. Excavate as necessary for proper placement and forming of concrete site elements and pavement structure. Remove vegetation and deleterious material and remove from site.
   b. Backfill over-excavated areas with compacted base material specified in Section 31 2324.
   c. Remove and replace exposed material that becomes soft or unstable.
2. Utility Trenches:

a. Unless otherwise indicated, excavation shall be open cut. Short sections of trench may be tunneled if pipe or duct can be safely and properly installed and backfill can be properly tamped in tunnel sections and if approved by Architect.
b. Excavate to proper alignment, depth, and grade. Excavate to sufficient width to allow adequate space for proper installation and inspection of utility piping.
c. If trenches are excavated deeper than required, backfill until trench bottom is proper depth with properly compacted native material.
d. Pipe 4 Inches 100 mm In Diameter Or Larger:
    1) Grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its length.
    2) Except where rock is encountered, take care not to excavate below depths indicated.
        a) Where rock excavations are required, excavate rock with minimum over-depth of 4 inches 100 mm below required trench depths.
        b) Backfill over-depths in rock excavation and unauthorized over-depths with loose, granular, moist earth, thoroughly compacted.
    3) Whenever wet or unstable soil incapable of properly supporting pipe, as determined by Architect, occurs in bottom of trench, remove soil to depth required and backfill trench to proper grade with coarse sand, fine gravel, or other suitable material acceptable to Architect.

3. If unusual excavating conditions are encountered, stop work and notify Architect.

3.4 REPAIR / RESTORATION

A. Repair damage to other portions of the Work resulting from work of this Section at no additional cost to Owner. On new work, arrange for damage to be repaired by original installer.

3.5 CLEANING

A. Debris and material not necessary for Project are property of Contractor and are to be removed before completion of Project. However, if material necessary for Project is hauled away, replace with specified fill / backfill material.

END OF SECTION

SECTION 31 2323

FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Perform Project backfilling and compacting as described in Contract Documents, except as specified below.
2. Procedure and quality for backfilling and compacting performed on Project under other Sections unless specifically specified otherwise.

B. Related Requirements:
1. Section 31 0501: Common Earthwork Requirements.
2. Division 32: Compaction of sub-grade under walks and paving.
3. Performance of backfilling and compacting outside of building required for electrical work is responsibility of respective Section doing work unless arranged differently by Contractor.

1.2 REFERENCES

A. Reference Standards:
1. ASTM International:
   a. ASTM D 1557-02, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.'
   b. ASTM D 2216-98, 'Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.'
   c. ASTM D 2487-00, 'Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).'
   d. ASTM D 2922-05, 'Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).'
   e. ASTM D 3017-05, 'Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).'

B. Definitions:
1. Relative Compaction: Ratio of field dry density as determined by ASTM D 2922 and ASTM D 3017 or 2216, and laboratory maximum dry density as determined by ASTM D 1557.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 31 2213.

B. Sequencing:
1. Before backfilling, show utility and service lines being covered on record set of Drawings. Do not backfill until utilities involved have been tested and approved by Architect and until instructed by Architect.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Site Material: Existing excavated material on site is suitable for use as fill and backfill to meet Project requirements.

B. Imported Fill / Backfill:
1. Well graded material conforming to ASTM D 2487 free from debris, organic material, frozen materials, brick, lime, concrete, and other material which would prevent adequate performance of backfill.
   a. Under Paved Areas: Fill shall comply with soil classification groups GW, GP, GM, SW, SP, or SM. Fill may not contain stones over 6 inches 150 mm diameter and 90 percent minimum of fill shall be smaller than 1-1/2 inch 38 mm in any direction.
   b. Under Landscaped Areas:
      1) Fill more than 36 inches 900 mm below finish grade shall comply with soil classification groups GW, GP, GM, SW, SP, or SM. Fill may not contain stones over 6 inches 150 mm diameter and 90 percent minimum of fill shall be smaller than 1-1/2 inch 38 mm in any direction.
      2) Fill less than 36 inches 900 mm below finish grade shall comply with soil classification groups SW, SP, SM, or SC. Fill may not contain stones larger than 1-1/2 inches 38 mm in any direction and 90 percent minimum of fill shall be smaller than 3/8 inch 4.7 mm in any direction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before placing fill, base, or finish work, prepare sub-grade as follows:
1. Do not place fill or base over frozen sub-grade.
2. Concrete Site Elements, And Concrete Driveways And Parking Areas: Scarify sub-grade 6 inches 150 mm deep, moisture condition to uniform moisture content of between optimum and 4 percent over optimum, and mechanically tamp 6 inches 150 mm deep to 90 percent minimum of relative compaction.
3. Under Asphalt Driveways And Parking Areas: Scarify sub-grade 6 inches 150 mm deep, moisture condition to uniform moisture content between optimum and 4 percent over optimum, and mechanically tamp to 95 percent minimum of relative compaction.
4. Landscape Areas: Compact sub-grade to 85 percent relative compaction.

3.2 PERFORMANCE

A. Fill / Backfill:
1. General:
   a. Around Buildings And Structures: Slope grade away from building as specified in Section 31 2216. Hand backfill when close to building or where damage to building might result.
   b. Site Utilities:
      1) In Landscape Areas: Use backfill consisting of on-site soil.
      2) Under Pavement And Concrete Site Elements: Extend excavatable slurry fill / backfill to elevation of subgrade. Do not place base material until excavatable slurry fill / backfill has cured 72 hours.
   c. Do not use puddling or jetting to consolidate fill areas.
2. Compacting:
   a. Fill / Backfill And Base:
      1) Under Building Slabs or Pads, Driveways, And Parking Areas: Place in 8 inch 200 mm maximum layers, moisture condition to plus or minus 2 percent of optimum moisture

content, and mechanically tamp to 95 percent minimum of maximum density as established by ASTM D 1557.

2) Under Concrete Site Elements And Around Foundation Walls: Place in 8 inch 200 mm maximum layers, dampen but do not soak, and mechanically tamp to 90 percent minimum of maximum density as established by ASTM D 1557.
3) Utility Trenches:
   a) Site: Place fill in 12 inch 300 mm layers and moisture condition to plus or minus 2 percent of optimum moisture content. Compact fill to 90 percent minimum relative compaction to within 12 inches 300 mm of finish grade. Compact fill above 12 inches 300 mm to 85 percent relative compaction.
   b) Under Slabs: Place fill in 6 inch 150 mm layers, moisture condition to plus or minus 2 percent of optimum moisture content, and compact to 95 percent minimum relative compaction to within 4 inches 100 mm of finish grade. Final 4 inches 100 mm of fill shall be granular base as specified in Section 31 2324.
4) Fill Slopes: Compact by rolling or using sheepsfoot roller.
5) Backfill Under Footings: Not allowed.
6) Other Backfills: Place other fills in 12 inch 300 mm layers and compact to 90 percent relative compaction.

3.3 REPAIR / RESTORATION

A. Repair damage to other portions of the Work resulting from work of this Section at no additional cost to Owner. On new work, arrange for damage to be repaired by original installer.

3.4 CLEANING

A. Debris and material not necessary for Project are property of Contractor and are to be removed before completion of Project. However, if material necessary for Project is hauled away, replace with specified fill / backfill material.

END OF SECTION

SECTION 31 2324

GRANULAR BASE

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Furnish and install granular base as described in Contract Documents.

B. Related Requirements:
1. Section 03 3053: Granular base under miscellaneous cast-in-place concrete.
2. Section 31 0501: Common Earthwork Requirements.
3. Section 32 1216: Base course under asphalt paving.

1.2 REFERENCES

A. Reference Standards:
1. ASTM International:
   a. ASTM E 1643-98 (2005), 'Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.'

PART 2 - PRODUCTS

2.1 MATERIALS

A. Granular Base:
1. Gravel: 1/4 inch 6mm minimum to one inch 25 mm maximum well-graded, clean gravel or crushed rock.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Place 4 inches 100 mm minimum of granular base level, and compact with two passes of 2-1/2 ton minimum roller.

B. Do not allow water onto granular base before placing concrete.

3.2 FIELD QUALITY CONTROL

A. Notify Architect 2 days before installation of concrete to allow inspection of granular base installation.

END OF SECTION

SECTION 31 2500

EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Provide permanent erosion and sedimentation controls as described in Contract Documents.

B. Related Requirements:
1. Section 01 5700: Temporary Erosion and Sedimentation Control.
2. Section 02 4113: Selective Site Demolition.
3. Section 31 0501: Common Earthwork Requirements.
4. Section 31 1100: Clearing and Grubbing.
5. Section 31 1413: Topsoil Stripping And Stockpiling.

1.2 REFERENCES

A. References:
1. United States Environmental Protection Agency:
   a. EPA Document 832/R-92-005 (Sep 1992), 'Storm Water Management for Construction Activities.'

1.3 SUBMITTALS

A. Informational Submittals:
1. Delegated Design Submittals:
   a. Sediment and erosion control plan, specific to site, meeting following objectives:
      1) Prevent loss of soil, including soil stockpiled for reuse, by storm water runoff and wind erosion.
      2) Prevent sedimentation of storm sewers and receiving streams.
      3) Prevent air pollution by dust and particulate matter.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Sediment and erosion control shall conform to EPA Document 832/R-92-005, Chapter 3, or local erosion and sedimentation control standards, whichever is more stringent.

B. Qualifications: Supervisor of erosion control operations shall be thoroughly familiar with types of erosion control materials being installed and best methods for their installation. Supervisor shall be present when work of this Section is being performed and shall direct work performed under this Section.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Performance:

1. Design Criteria: Protect and maintain areas disturbed by the Work, so erosion is adequately controlled and silt and sediments are not allowed to flow into any watercourse, onto adjacent properties, or into storm drains.

B. Materials:

1. Hay And Straw Mulch:
   a. General:
      1) Reasonably free from swamp grass, weeds, twigs, debris and other deleterious materials, and free from rot, mold, primary noxious weed seeds, and rough or woody materials.
      2) Mulches containing mature seed of species which would volunteer and be detrimental to permanent seeding, or would result in over-seeding, or would produce growth which is aesthetically unpleasing, is not permitted.
   b. Hay Mulch:
      1) Properly aired native hay, Sudan grass hay, broom sedge hay, legume hay, or similar hay or grass mowings.
      2) Apply at 2 to 3 tons per acre unnetted or stabilized, or at 1.5 tons per acre when net or mulch stabilizer is used. When air-dried and in loose state, contents of representative bale shall lose not more than 15 percent of resulting air-dry weight of bale.
   c. Straw Mulch:
      1) Threshed plant residue of oats, wheat, barley, rye, or rice from which grain has been removed.
      2) Apply at 2 to 3 tons per acre unnetted or stabilized, or at 1.5 tons per acre when net or mulch stabilizer is used.
   d. Matting:
      1) Jute Matting:
         a) Undyed and unbleached jute yarn woven into uniform open, plain weave mesh and furnished in rolled strips. Matting shall conform to following physical requirements:
         b) 48 inches wide, plus or minus one inch.
         c) 78 warp ends per width of cloth.
         d) 41 weft ends per yard.
         e) 1.22 to 1.80 lbs per lineal yard, plus or minus 5 percent.
   e. Excelsior Matting:
      1) Uniform web of interlocking wood excelsior fibers with a backing of mulch net fabric on one side only and furnished in rolled strips. Mulch net shall be woven of either twisted paper or cotton cord. Matting shall conform to following physical requirements:
         a) 36 inches wide, plus or minus one inch.
         b) 0.80 lbs per sq yd, plus or minus 5 percent.
   f. Soil Erosion Matting:
      1) Type Two Acceptable Products.
         a) 'Enkamat Type 7020' by American Enka Company.
         b) Equal as approved by Architect before use. See Section 01600.
   g. Erosion Control Mulching Blanket:
      1) Type Two Acceptable Products.
         a) 'Hold/Gro' by Gulf States Paper Corp.
         b) Equal as approved by Architect before use. See Section 01600.
2. Seed And Sod For Erosion Control:
   a. For Temporary Control: Annual or perennial ryegrass.
   b. For Permanent Control: See Sections under 02900 heading.
3. Hay Bales For Erosion Control:
   a. Rectangular shaped bales of hay or straw, weighing at least 40 pounds per bale, free from primary noxious weed seeds and rough or woody materials.
4. Silt Fences:
   a. Type Two Acceptable Products
      1) 'Geofab Silt Fence' by Mercantile Development Inc.
      2) 'Mirafi 100X by Celanese Fibers Marketing Co.
      3) Equal as approved by Architect before use. See Section 01 6200.

2.2 ACCESSORY PRODUCTS

A. For Mulch:
1. Mulch Stabilizers:
   a. Type Two Acceptable Products
      1) 'Curasol' applied at 40 gallons per acre.
      2) Dow 'Mulch Binder' applied at 45 gallons per acre.
      3) Asphalt binder meeting requirements of AASHTO M140, Type SS-1 or RS-1 as applicable and applied at 400 gallons per acre.
      4) Equal as approved by Architect before use. See Section 01 6200.
2. Temporary Type Mulch Nets: Paper yarn, approximately 0.05 inches in diameter, woven into net with openings of approximately 7/8 inch by 1/2 inch and weight of approximately 0.20 lbs per sq yd.
3. Permanent Type Mulch Nets:
   a. Type Two Acceptable Products:
      1) 'Vexar' or 'Erosion-Net' plastic or nylon mesh netting with openings of approximately 3/8 to 3/4 inch.
      2) Equal as approved by Architect before use. See Section 01 6200.

B. For Matting / Blankets:
1. Staples: 11 ga minimum plain iron wire, made from 12 inch minimum lengths of wire bent to form 'U' of 1-1/2 inches to 2 inches in width with equal legs of 5 to 5-1/4 inches. Use longer staples for loose soils or where otherwise required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Take every reasonable precaution to avoid erosion and to prevent silting of rivers, streams, lakes, reservoirs, impoundments, and drainage ditches and swales.
2. Keep exposure of uncompleted cut slopes, embankments, trench excavations, and site graded areas as short as possible. Initiate seeding and other erosion control measures on each segment as soon as reasonably possible.
3. Should it become necessary to suspend construction for any length of time, shape excavated and graded areas so runoff will be intercepted and diverted to points where minimal erosion will occur. Provide and maintain temporary erosion and sediment control measures, such as berms, dikes, slope drains, silt stops, and sedimentation basins, until permanent drainage facilities or erosion control features have been completed and are operative.
4. Handle and treat fine material placed or exposed during The Work so as to minimize possibility of it reaching surface waters. Use diversion channels, dikes, sediment traps, or other effective control measures.
5. Provide silt stops wherever erosion control measures may not be totally capable of controlling erosion, such as in drainage channels and where steep slopes may exist.
6. Before water is allowed to flow in any ditch, swale, or channel, install permanent erosion control measures in waterway so waterway will be safe against erosion.
7. Take precautions in using construction equipment to minimize erosion. Do not leave wheel tracks where erosion might begin.
8. Unless specifically required in Contract Documents, operation of mechanized equipment in watercourses is not permitted. Where work is required in watercourses, minimize movement of equipment in the water and remove false work, pilings, debris, and other temporary work as soon as construction will allow.
9. Wherever crossings of live streams are necessary, provide temporary culverts or bridges to allow equipment to cross them without fording. Disturbance of lands and waters outside limits of construction is prohibited, except as may be found necessary and approved in writing by Architect.
10. Mulching shall follow seeding operations by no more than 24 hours.

11. Continue erosion control measures until permanent measures have been sufficiently established and are capable of controlling erosion on their own.

B. Hay And Straw Mulching:
1. Install hay or straw mulch immediately after areas have been properly prepared.
   a. When permanent seed or seed for temporary erosion control is sown prior to placing mulch, place mulch on seeded areas within 24 hours after seeding.
   b. Architect may authorize blowing of chopped mulch provided that 95 percent of mulch fibers will be 6 inches or more in length and that mulch can be applied in so there will be a minimum amount of matting that would retard plant growth.
   c. Hay mulch should cover ground enough to shade it, but should not be so thick that a person standing cannot see ground through mulch.
   d. Remove matted mulch or branches.
2. Where mild winds that may blow mulch are probable, when ground slopes exceed 15 percent, or when otherwise required to maintain mulch firmly in place, apply a system of pegs and strings, a chemical stabilizer, or temporary type netting to mulch. Unless otherwise directed, remove strings and netting prior to acceptance of the Work.
3. Where high winds or heavy rainstorms are likely, where ground surfaces are steeper than 15 percent, or where other conditions require, apply temporary type netting over mulch and take whatever other measures are necessary to maintain mulch firmly in place.
4. Unless otherwise specified, use of permanent type netting is not permitted without prior written approval of Architect

C. Matting:
1. General:
   a. Use of mulch with matting is not permitted. However, 4 to 6 inch overlap of mulch over edge of matting is allowed.
   b. Prepare surfaces of ditches and slopes to conform to grades, contours, and cross sections shown on Drawings. Finish to smooth, even condition with debris, roots, stone, and lumps raked out and removed. Loosen soil surface sufficient to permit bedding of matting. Unless otherwise noted, place seed prior to placement of matting.
   c. Unroll matting parallel to direction of water flow and loosely drape, without folds or stretching, so continuous ground contact is maintained.
   d. In ditches and swales and on slopes, place each upslope and each downslope end of each piece of matting in 6 inch trench, stapled at 12 inches on center, backfilled, and tamped. Similarly, bury edges of matting along edges of catch basins and other structures. Architect may require that other edges exposed to more than normal flow of water be buried in similar fashion.
   e. Tightly secure matting to soil with staples driven approximately vertically into ground, flush with matting surface. Do not form depressions or bulges in matting surface with staples.
   f. Increase specified spacing of staples when factors such as season of year or amount of water encountered or anticipated require additional anchoring.
2. Jute Matting:
   a. Where strips are laid parallel or meet, as in a tee, overlap 4 inches minimum. Overlap ends 6 inches minimum, shingle fashion.
   b. Space check slots built at right angles to direction of water flow so one check slot or one end occurs within each 50 feet of slope length. Construct check slots by placing tight fold of matting 6 inches minimum vertically into ground. Tamp these same as upslope ends.
   c. Press jute matting onto ground with light lawn roller or other satisfactory means.
   d. On slopes flatter than 4:1, place staples 36 inches apart maximum in three rows for each strip, with one row along each edge and one row alternately spaced down center. On grades 4:1 or steeper, place staples in the same three rows, but spaced 24 inches apart. On lapping edges, reduce spacing of staples by half. At ends of matting and at required check slots, space staples 12 inches apart. Staple matting placed adjacent to boulders or other obstructions with no spaces between staples.
   e. Spread additional seed over jute matting, particularly those locations disturbed by building of slots.
3. Excelsior Matting:
   a. Where strips of excelsior matting are laid end-to-end, butt adjoining ends.
   b. When adjoining rolls of excelsior matting are laid parallel to one another, butt matting snugly.

c. On slopes flatter than 4:1, place staples 36 inches maximum apart in three rows for each strip, with one row along each edge and one row alternately spaced down center. On grades 4:1 or steeper, place staples in same three rows, but spaced 24 inches apart. Space staples in ends of matting 12 inches apart. Staple matting placed adjacent to boulders or other obstructions with no spaces between staples.

4. Erosion Control Mulching Blanket:
   a. Where one roll ends and second roll begins, bring end of upslope piece over end of downslope roll so there is 12 inch overlap. Place overlap in 4 inch deep trench, staple at 12 inches on center, and backfill and tamp.
   b. On slopes where two or more widths of blanket are applied, overlap edges 4 inches and staple at 12 inch intervals along exposed edge of lap joint.
   c. Staple body of blanket in grid pattern with staples 36 inches on center, each way.

D. Seed For Erosion Control:
1. Seeding for permanent erosion control shall be carried out in accordance with appropriate Section under 02900 heading.
2. Areas that will be regraded or otherwise disturbed later during construction may be seeded with rye grass to obtain temporary control. Sow seed at one lb per 1,000 sq ft, on pure live seed basis.

E. Hay Bales And Silt Fences:
1. Provide hay bales or silt fences, as required, for temporary control of erosion and to stop silt and sediment from reaching surface waters, adjacent properties, or entering catch basins, or damaging the Work.
2. Stake hay bales firmly in place. Use sufficient number of bales to accommodate runoff without causing flooding and to adequately store any silt, sediment, and debris reaching them.
3. Erect silt fences and bury bottom edge in accordance with Manufacturer's recommended installation instructions. Provide sufficient length of fence to accommodate runoff without causing flooding and to adequately store any silt, sediment, and debris reaching it.

3.2 REPAIR / RESTORATION

A. If any staple becomes loosened or raised, if any matting becomes loose, torn, or undermined, or if any temporary erosion and sediment control measures are disturbed, repair them immediately.

B. If seed is washed out before germination, repair damage, refertilize, and reseed.

C. Maintain mulched and matted areas, silt stops, and other temporary control measures until permanent control measures are established and no further erosion is likely.

END OF SECTION

DIVISION 32: EXTERIOR IMPROVEMENTS

32 1000 BASES, BALLASTS, AND PAVING

32 1216 ASPHALT PAVING

32 3000 SITE IMPROVEMENTS

32 3213 CAST-IN-PLACE CONCRETE RETAINING WALLS

32 8000 IRRIGATION

32 8423 UNDERGROUND SPRINKLERS

32 9000 PLANTING

32 9001 COMMON PLANTING REQUIREMENTS
32 9113 SOIL PREPARATION
32 9120 TOPSOIL PLACEMENT AND GRADING
32 9222 HYDRO-SEEDING
32 9300 PLANTS
32 9413 LANDSCAPE EDGING

END OF TABLE OF CONTENTS

SECTION 32 1216*

ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Prepare pavement sub-grade as described in Contract Documents to receive pavement base and paving.
2. Furnish and install pavement base and asphaltic concrete paving in driveways and parking areas as described in Contract Documents.

B. Related Requirements:
1. Section 31 2323: Compaction procedures and tolerances for fill.

1.2 REFERENCES

A. Reference Standards:
1. ASTM International:
   a. ASTM C 131-03, 'Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.'
   b. ASTM D 977-05, 'Standard Specification for Emulsified Asphalt.'
   c. ASTM D 1075-96 (2005), 'Standard Test Method for the Effect of Water on Compressive Strength of Compacted Bituminous Mixtures.'
   d. ASTM D 1188-96 (2002), 'Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Specimens.'
   e. ASTM D 2027-97 (2004), 'Standard Specification for Cutback Asphalt (Medium-Curing Type).'
   f. ASTM D 2041-03a, 'Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.'
   g. ASTM D 2397-05, 'Standard Specification for Cationic-Emulsified Asphalt.'
   h. ASTM D 2726-05a, 'Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens.'
   i. ASTM D 3381-05, 'Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.'

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
1. Participate in pre-installation conference specified in Section 31 2213.
2. Schedule paving pre-installation conference after staking of parking areas and installation of sleeves, but before installation of base and paving.

1.4 SUBMITTALS

A. Action Submittals:
1. Product Data: Manufacturer's published product data on pre-emergent herbicide.

B. Informational Submittals:
1. Design Data: Mix design of asphalt concrete mixture.

2. Test And Evaluation Reports: Copies of test results from tests conducted to assure compliance to Contract Document requirements.
3. Manufacturer Instructions: Application instructions for pre-emergent herbicide.

1.5 QUALITY ASSURANCE

A. Qualifications: Pre-emergent herbicide shall be applied by applicator certified by State in which Project is located as an applicator of agricultural chemicals.

1.6 FIELD CONDITIONS

A. Ambient Conditions:
1. Do not perform work during following conditions:
   a. Ambient temperature or temperature of base below 50 deg F 10 deg C.
   b. Presence of free surface water.
   c. Over-saturated base and sub-grade materials.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Pre-emergent herbicide:
1. Selective type pre-emergence control chemical containing 40 percent Trifluralin minimum.
2. Labeled for under-pavement use.
3. Type Two Acceptable Products:
   a. Treflan or Spike 80W by Dow AgroSciences, Indianapolis, IN www.dowagro.com.
   b. Trust 4EC by Agriliance LLC, St Paul, MN www.agriliance.com.
   c. Equal as approved by Architect before installation. See Section 01 6200.

B. Base:
1. New Aggregate Base:
   a. Road Base type gravel or crushed stone, graded as follows:

1) Sieve	Percent by Weight Passing Sieve
a) 1 inch	100
b) 3/4 inch	85 - 100
c) No. 4	45 - 60
d) No. 10	30 - 50
e) No. 200	5 - 10 (non-plastic)
f) 25 mm	100
g) 19 mm	85 – 100
h) No. 4	45 – 60
i) No. 10	30 – 50
j) No. 200	5 - 10 (non-plastic)

2. Recycled Aggregate Base:
   a. Pulverized existing asphalt or concrete paving mixed uniformly with existing aggregate base.
   b. Conform to following gradation:

1) Sieve	Percent by Weight Passing Sieve
a) 2 Inch	100
b) 1-1/2 inch	85 – 100
c) 3/4 inch	60 – 80
d) No. 4	30 – 50
e) No. 200	5 – 12
f) 50 mm	100
g) 38 mm	85 – 100
h) 19 mm	60 – 80

i) No. 4 30 – 50
j) No. 200 5 – 12

c. Quality Requirements as established by testing:
1) R-value: 70 minimum.
2) Sand Equivalent: 25 minimum.
3) Durability Index: 35 minimum.

C. Asphalt Cement Primer: Meet requirements of ASTM D 2027, MC 70, plus or minus one grade.

D. Tack Coat: Emulsified asphalt meeting requirements of either ASTM D 977, Grade SS-1H, or ASTM D 2397, Grade CSS-1H.

E. Pavement:
1. Asphalt Cement:
a. Meet requirements of ASTM D 3381, Viscosity grade (Original Asphalt) as follows:
1) AC5 in cold climatic conditions.
2) AC10 in moderate climatic conditions.
3) AC20 in hot climatic conditions.
2. Aggregates:
a. Fine to coarse mineral aggregates with wear less than 40 percent as determined by ASTM C 131 and mineral filler suitable for pavement meeting following gradation requirements:

1) Sieve	Percent by Weight Passing Sieve
a) 1/2 inch	100
b) 3/8 inch	85 – 100
c) No. 4	65 – 80
d) No. 8	50 – 60
e) No. 30	25 – 40
f) No. 80	18 – 30
g) No. 200	3 – 8
h) 3 mm	100
i) 9.5 mm	85 – 100
j) No. 4	65 – 80
k) No. 8	50 – 60
l) No. 30	25 – 40
m) No. 80	18 – 30
n) No. 200	3 – 8

b. Up to 15 percent by weight of total aggregates may consist of pulverized, recycled asphalt cement concrete pavement, providing aggregate grading requirements are met.

2.2 MIXES

A. Central plant hot mix.

B. Develop mix design according to Marshall Method to achieve optimum asphalt content as shown by test data curves based on testing samples containing 1/2 percent increments of asphalt content. Samples shall include minimum of two with asphalt content above optimum and two with asphalt content below optimum.
1. Make tests in accordance with ASTM D 1559 and ASTM D 1075 (50 blow count Marshall).
2. Final design shall meet following criteria:
a. Stability: 1200 pounds 545 kg minimum.
b. Flow: 8 minimum, 18 maximum.
c. Air voids: 2 percent minimum, 4 percent maximum.
d. Voids in mineral aggregate: 15 percent minimum.
e. Asphalt cement by weight of total: 5 percent minimum.
f. Dry Strength: 200 psi 975 kg per sq m.
g. Index of Retained Strength: 75 percent.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Approved Applicators:
1. Geneva Rock
2. Miller Paving
3. Morgan Asphalt
4. Staker Paving

3.2 PREPARATION

A. Survey and stake parking surfaces to show grading required by Contract Documents.

B. Sub-Grade:
1. Finish grade parking surface area to grades required by Contract Documents.
2. Compact sub-grade as specified in Section 31 2323.

C. Pre-emergent Herbicide:
1. Apply to prepared subgrade dispersed in liquid. Concentrate shall be such that Manufacturer's full recommended rate of chemical will be applied to every 1000 sq ft 100 sq m and liquid will penetrate a minimum of 2 inches 50 mm.
2. Application shall be no more than one day before installation of base.
3. Take necessary precautions to protect adjoining property and areas designated for planting on building site.

3.3 INSTALLATION

A. Tolerances:
1. Sub-Grade: 0.00 inchesmm high. Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
2. Base:
   a. Base shall be 6 inches 150 mm thick minimum after compaction, except where shown thicker on Drawings.
   b. Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
3. Paving:
   a. Apply asphaltic concrete paving in single lift 3 inches 75 mm thick minimum after compaction, except where shown thicker on Drawings. Paving thicker than 3 inches 75 mm may be applied in two lifts, the first 2 inches 50 mm thick minimum and the second 1-1/2 inches 38 mm thick minimum.
   b. Paving adjacent to cast-in-place concrete site elements shall be between 1/4 inch 6 mm higher than concrete and flush with concrete.
   c. Surface texture of hand worked areas shall match texture of machine-laid areas.

B. Base:
1. If roller is smaller than 8 ton 7260 kg, lay gravel and compact in two courses.
2. Compact as specified in Section 31 2323.
3. Priming: Prime base with application of 0.2 to 0.5 gallons 2 to 5 liters of asphalt cement primer per square yardmeter if pavement will be laid more than three days after compaction of base, or if precipitation is anticipated between completion of compaction of base and laying of pavement.
4. Recompact unprimed base if it receives precipitation before pavement is laid.
5. Remove or repair improperly prepared areas as directed by Architect.

C. Asphalt Paving:
1. Tack coat vertical concrete surfaces that will be in contact with paving.
2. Uniformly mix materials so aggregate is thoroughly coated with asphalt.

3. Place at temperatures between 250 and 325 deg F 120 and 163 deg C with a self-propelled laydown machine.
4. Longitudinal bituminous joints shall be vertical and properly tack coated if cold. Transverse joints shall always be tack coated.
5. Compaction:
   a. Compact asphalt paving to 96 percent minimum. Determine percent compaction by dividing density of test cores as determined by either ASTM D 1188 or ASTM D 2726 by laboratory compacted density as determined by ASTM D 1559. Maximum total air voids in completed asphaltic concrete shall be 8 percent as determined by ASTM D 2041.
   b. Roll with powered equipment capable of obtaining specified density.
   c. Begin breakdown rolling immediately after asphalt is placed when asphalt temperature is at maximum. Complete breakdown rolling before mix temperature drops below 240 deg F 115 deg C. Complete handwork compaction concurrently with breakdown rolling.
   d. Complete intermediate rolling as soon as possible after breakdown rolling and before mix temperature drops below 185 deg F 85 deg C. Do not roll paving for compaction purposes after asphalt temperature falls below 185 deg F 85 deg C.
   e. Execute compaction so visibility of joints is minimized. Complete finish rolling to improve asphalt surface as soon as possible after intermediate rolling and while asphalt paving is still warm. Do not use vibration for finish rolling.
6. Surface shall be uniform with no 'birdbaths.' Leave finished surfaces clean and smooth. Variations from specified grades shall not exceed 1/2 inch 13 mm.

3.4 FIELD QUALITY CONTROL

A. Field Tests: When tested with 10 foot 3 meter straight edge, surface of completed work shall not contain irregularities in excess of 1/4 inch 6 mm.

B. Laboratory Tests:
1. Arranage and pay for an independent testing laboratory, approved by the Project Manager, and select test locations, an equal number from near edges of paving and at random in field.
2. Arrange for selected laboratory to make tests after completion of work of this Section. After testing, repair test locations (with same material) as necessary and remove and replace work not in compliance with Contract Documents at no additional cost to Owner.
3. Testing laboratory will perform one test series for every 20,000 sq ft 1,800 sq M of parking.
   a. Tests reports will show compliance with Contract Documents regarding type of sub base, depth and density of base, depth and density of paving, and in materials used. Reports will also give test procedures used by testing laboratory.
   b. Testing laboratory will forward three copies of test report to Architect.
   c. All spills, spotting, or soiling of asphalt or liquid emulsion on concrete, sidewalks, curbs, wateways, buildings, etc., will be cleaned off thoroughly to Owner's satisfaction and will require approval by the Project Manager.

END OF SECTION

SECTION 32 3213

CAST-IN-PLACE CONCRETE RETAINING WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Furnish and install cast-in-place concrete retaining walls as described in Contract Documents

B. Related Requirements:
1. Section 03 3111: Concrete.
2. Section 31 2323: Compaction procedures and tolerances.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of weep holes with Section 07 1352.

1.3 QUALITY ASSURANCE

A. Meet quality assurance / control requirements specified in Section 03 3111.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Formwork: Meet requirements specified in Section 03 1113.

B. Concrete: Meet requirements specified in Section 03 3111 for exterior concrete.

C. Expansion Joints:
1. 1/2 inch 13 mm thick.
2. Recycled Vinyl Type:
   a. Light gray color.
   b. Type One Approved Products:
      1) Proflex by Oscoda Plastics Inc, Oscoda, MI www.oscodaplastics.com.
      2) Equal as approved by Architect before bidding. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Joints:
1. Scored Control Joints: 10 feet 3 000 mm on center maximum.
2. Expansion And Contraction Joints: 36 feet 10 800 mm on center minimum, 50 feet 15 000 mm maximum.

B. Weep Holes: Install minimum of two weep holes per section as shown on Drawings.

C. Finish:

1. Immediately after removing forms from retaining walls, remove joint marks, bellies, projections, loose materials, and cut back metal ties from surface to be exposed.
2. Point up voids with cement mortar, 1:2 mix, and rub exposed surface with carborundum to smooth, even surface.

3.2 FIELD QUALITY CONTROL

A. Field Inspections: Notify Architect seven days minimum before placing concrete retaining walls.

END OF SECTION

SECTION 32 8423

UNDERGROUND SPRINKLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Furnish and install planting irrigation system as described in Contract Documents complete with accessories necessary for proper function.

B. Related Requirements:
1. Section 22 1116: Stop and waste valve.
2. Division 26: Controller conduit and power to controller.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Schedule pre-installation conference before irrigation system installation begins. In addition to items listed in Division 01, demonstrate or describe method to be used to maintain head spacing from concrete and to stabilize heads.

B. Sequencing: Install sleeves before installation of cast-in-place concrete site elements and paving.

1.3 SUBMITTALS

A. Informational Submittals:
1. Test And Evaluation Reports: Results of service pressure test before beginning work on system.

B. Closeout Submittals:
1. Record Drawings:
   a. As installation occurs, prepare accurate record drawing to be submitted before final inspection, including:
      1) Detail and dimension changes made during construction.
      2) Significant details and dimensions not shown in original Contract Documents.
      3) Field dimensioned locations of valve boxes, manual drains, quick-coupler valves, control wire runs not in mainline ditch, and both ends of sleeves.
      4) Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
      5) Take and record dimensions at time of installation.
   b. Reduce copy of record drawing to 11 by 17 inches 275 by 425 mm, color key circuits, and laminate both sides with 5 mil thick or heavier plastic. Mount on 1/4 inch 6 mm plywood board. Drill two 1/2 inch 13 mm holes at top of board and hang on hooks in Custodial Room.
2. Operations And Maintenance Manual Data:
   a. Modify and add to requirements of Section 01 7800 as follows:
      1) Instruction manual that contains complete instructions for system operation and maintenance, including winterizing and first year's scheduling.
      2) Complete instructions on how to drain entire backflow preventer to prevent freezing.
      3) Manufacturer's cut sheets for each element of system.
      4) Parts lists for operating elements of system.
      5) Manufacturer's printed literature on operation and maintenance of operating elements of system.

3. Final payment for system will not be authorized until Closeout Submittals are received and accepted by Architect.

C. Maintenance Material Submittals:
1. Tools:
   a. Furnish following items before Final Closeout Review:
      1) One heavy-duty key for stop and waste or main shut-off valve.
      2) One quick coupler key with brass hose swivel.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials shall be in accordance with latest rules and regulations, and other applicable state or local laws. Nothing in Contract Documents is to be construed to permit work not conforming to these codes.

B. Qualifications:
1. Installers:
   a. Use only trained personnel familiar with required irrigation system installation procedures.
   b. Perform installation under direction of foreman or supervisor with five years minimum experience in sprinkling system installations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. During delivery, installation, and storage, protect materials from damage and prolonged exposure to sunlight.

1.6 WARRANTY

A. Standard one year guarantee stipulated in General Conditions Article 12.2 shall include:
1. Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
2. Adjusting system to supply proper coverage of areas to receive water.
3. Ensuring system can be adequately drained.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
1. Manufacturer List:
   a. Action Machining Inc, Bountiful, UT www.actionfilters.com.
   b. Carson Industries LLC, Glendora, CA www.carsonind.com.
   c. Hunter Industries, San Marcos, CA www.hunterindustries.com.
   d. Nibco Inc, Elkhart, IN www.nibco.com.
   e. Rain Bird Sprinkler Manufacturing Corp, Glendora, CA www.rainbird.com.
   f. Salco Products, Fontana, CA www.salcodrip.com.
   g. 3M, Austin, TX www.3m.com/elpd.
   h. Weathermatic Irrigation Products, Garland, TX www.weathermatic.com.

B. Materials:
1. Rock-Free Soil:
   a. Backfill soil around PVC pipe.
   b. Soil having rocks no larger than 1/2 inch 12 mm in any dimension.
2. Pea Gravel:

a. For use around drains, valves, and quick couplers.
b. 1/2 inch 12 mm maximum dimension, washed rock.

3. Sand: Fine granular material naturally produced by rock disintegration and free from organic material, mica, loam, clay, and other deleterious substances.
4. Native Material: Soil native to project site free of wood and other deleterious materials and rocks over 1-1/2 inches 38 mm.
5. Topsoil: Remove rocks, roots, sticks, clods, debris, and other foreign matter over 1-1/2 inches 38 mm longest dimension encountered during trenching.
6. Pipe, Pipe Fittings, And Connections:
   a. Pipe shall be continuously and permanently marked with Manufacturer's name, size, schedule, type, and working pressure.
   b. Pipe sizes shown on Drawings are minimum. Larger sizes may be substituted if at no additional cost to Owner.
   c. Hardiness Zone 1 Through 4 Pipe:
      1) Pressure Lines: Schedule 40 PVC.
      2) Lateral Lines: Schedule 40 PVC.
      3) Backflow Assembly Piping: Galvanized steel.
      4) Quick Coupler Piping: Galvanized steel.
   d. Fittings: Same material as pipe, except where detailed otherwise.
   e. Sleeves:
      1) Under Parking Area And Driveway Paving: Schedule 40 PVC Pipe.
      2) All Other: Class 200 PVC Pipe.
      3) Sleeve diameter shall be two times larger than pipe installed in sleeve.
7. Sprinkler Heads:
   a. Each type of head shall be product of single manufacturer.
   b. Spray Heads in Lawn Areas:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
         a) Hunter: see plans.
         b) Rainbird: see plans.
   c. Stream Heads, 16 to 22 foot in Shrub Areas:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
         a) Rainbird: see plans
         b) Walla Walla Sprinkler: MP Rotator
   d. Gear Driven Rotor Pop-ups:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
         a) Hunter: PGS Series (shrub), PGP Series (30 to 52 feet), I-10 Shrub Series, I-20 Series (17 to 45 feet), I-25, I-40 Series (40 to 70 feet). See plans.
         b) Rainbird: 5000/5000 plus MPR series, 25'-35', R-50 series (21'-50'), 5500 Series (33'-55'). See plans.
8. Sprinkler Risers:
   a. Pop-up rotor sprinkler heads shall have adjustable riser assembly, three ell swing joint assembly, unless detailed otherwise on Drawings. These swing joint fittings shall be of schedule 40 PVC plastic and nipples schedule 80 gray PVC unless otherwise designated on Drawings. Horizontal nipple parallel to side of lateral line shall be 8 inches 200 mm long minimum. All other nipples on swing joint riser shall be of length required for proper installation of sprinkler heads.
   b. Pop-up sprinkler heads, shrub spray heads, bubbler heads, and stationary spray sprinkler heads shall have risers made up one of the following ways:
      1) Three schedule 40 street ells or Marlex street ells connected to lateral tee to form an adjustable riser or pop-up riser as detailed.
      2) Risers for sprinkler heads 14 inches 350 mm long minimum and 24 inches 600 mm maximum.
         a) Type Two Acceptable Products:
         b) Rainbird: Swing Pipe with barbed fittings.
         c) Equal as approved by Architect before installation. See Section 01 6200.
9. Automatic Irrigation Control Wiring And Controller:
   a. Control wire shall be UF-UL listed, color coded PVC insulated copper conductor direct burial size 14 or PE insulated 14 AWG color coded wire. Do not use green color coded wire.
   b. Waterproof Wire Connectors:
      1) Type Two Acceptable Products:

a) DBY or DBR by 3M
b) Equal as approved by Architect before installation. See Section 01 6200.

c. Automatic controllers:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Hunter:
(1) 3 to 15 Stations: PRO-C Series.
(2) 8 to 32 Stations: ICC Series.
b) Rainbird:
(1) 4 to 13 Stations: ESP Modular Series.
(2) 6 to 24 Stations: ESP-LX Modular.
(3) 8 to 40 Stations: ESP-MC Series.
c) Weathermatic: 4 to 30 Stations: LMC Series.

d. Automatic Rain Sensors:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Hunter: MINI-CLIK, RAIN-CLIK, WRC, WRFC.
b) Rainbird: WRC (wireless rain sensor), RSD-BEx (w/bracket)
c) Weathermatic : 955 Rain Sense

10. Valves:
a. Manual Drain Valves:
1) PVC ball valve with 'T' handle on main lines and in valve boxes on lateral lines.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Rainbird: BV Series, 1/2 inch.

b. Automatic Valves:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Rainbird: DVFUU Series, PGA series, PEB series, PESB series

c. Isolation Valves:
1) PVC ball valves, size to match pipe size.
2) Class Two Quality Standards. See Section 01 6200.
a) Rainbird: BV Series.
b) Salco

d. Backflow Preventer: Make and Model shown on Drawings or as required by local code.

e. Pressure Reducing Valve: Make and model shown on Drawings or as required by local code.

f. Quick Coupling Valves and Keys:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Rainbird: 33DRC, 33DLRC, 33DK with SH-O swivel.

11. Valve Accessories:
a. Valve manifolds:
1) Type Two Acceptable Products.
a) Action: 1800 Series, Models 18001, and 18002, 1, 1-1/2, and 2 inch 25, 38, and 50 mm sizes.
b) Rainbird: MS Series.
c) Equals as approved by Architect before use. See Section 01 6200.

b. Valve Boxes And Extensions:
1) Lid Colors:
a) Green: Lawn areas.
b) Brown: Bare soil and rock areas.
c) Purple: Secondary water.
2) Type Two Acceptable Products:
a) Carson Industries: Model 1419-12, Model 1419-18, Model 1730-18 Jumbo.
b) Equal as approved by Architect before use. See Section 01 6200.

c. Valve ID tags:
1) Type Two Acceptable Products:
a) Rainbird: VID1Y24, VID24Y48, VID1P24, VID24P48.
b) Equal as approved by Architect before use. See Section 01 6200.

d. Valve Box Supports: Standard size fired clay paving bricks without holes.

12. Drip System:
a. Drip Valve Assembly:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.

a) Hunter: PCZ 101 Series, ICZ 101 Series.
b) Rainbird:

PART 3 - Over 4 GPM: XCZ-100-B0COM series.

(2) Under 4 GPM: XCZ-075-PRF series.

a) Netafim:

(1) Over 4 GPM: LVCZ10075-HF.

(2) Under 4 GPM: LVCZ10075-LF.

b. Distribution Tubing:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Salco: PVC-AR flex hose with fittings.

c. Drip Emitters
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Salco: PST drip emitters, DMT multi-outlet emitters, wye strainers, filters, PVC fittings, distribution tubing, and tubing stakes.

2. Other Components:
a. Recommended by Manufacturer and subject to Architect's review and acceptance before installation.
b. Provide components necessary to complete system and make operational.

PART 4 - EXECUTION

4.1 INSTALLERS

A. Approved Installers:
1. Erickson Landscape 801-301-2110.
2. Star Landscape 801-554-6005.
3. Turf Sprinklers 801-943-5055.

4.2 EXAMINATION

A. Site Verification Of Conditions: Perform pressure test at stub-out on main water line provided for irrigation system, or at near-by fire hydrant. Notify Architect if pressures over 70 psi 480 kPAor under 55 psi 379 kPA are found to determine if some re-design of system is necessary before beginning work on system.

4.3 PREPARATION

A. Protection:
1. Repair or replace work damaged during course of the Work at no additional cost to Owner. If damaged work is new, installer of original work shall perform repair or replacement.
2. Do not cut existing tree roots measuring over 2 inches 50 mm in diameter in order to install irrigation lines.

B. Layout of Irrigation Heads:
1. Location of heads and piping shown on Drawings is approximate. Actual placement may vary slightly as is required to achieve full, even coverage without spraying onto buildings, sidewalks, fences, etc.
2. During layout, consult with Architect to verify proper placement and make recommendations, where revisions are advisable.
3. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.
4. Make certain changes from Contract Documents are shown on record drawings.

4.4 INSTALLATION

A. Trenching And Backfilling:
1. Pulling of pipe is not permitted.
2. Excavate trenches to specified depth. Remove rocks larger than 1-1/2 inch 38 mm in any direction from bottom of trench. Separate out rocks larger than 1-1/2 inch 38 mm in any direction uncovered in trenching operation from excavated material and remove from areas to receive landscaping.
3. Cover pipe both top and sides with 2 inches 50 mm of rock-free soil as specified under PART 2 PRODUCTS. Remainder of backfill to within 5 inches 125 mm of finish grade shall be as specified in Section 31 2323. Top 5 inches 125 mm of backfill shall be topsoil as specified in Section 32 9113.
4. Do not cover pressure main, irrigation pipe, or fittings until Architect has inspected and approved system.

B. Sleeving:
1. Sleeve water lines and control wires under walks and paving. Extend sleeves 6 inches 150 mm minimum beyond walk or pavement edge. Cover sleeve ends until pipes and wires are installed to keep sleeve clean and free of dirt and debris.
2. Position sleeves with respect to buildings and other obstructions so pipe can be easily removed.

C. Grades And Draining:
1. In localities where winterization is required, grade piping so system can be completely drained or blown out with compressed air. If system is not designed to be blown out with compressed air:
   a. Slope pipe to drain to control valve box where possible.
   b. Where this is not possible, slope pipe to a minimum number of low points. At these low points, install:
      1) 3/4 inch 19 mm brass ball valve for manual drain. Do not use automatic drain valves.
      2) Install 2 inch 50 mm Class 200 PVC pipe over top of drain and cut at finish grade.
      3) Provide rubber valve cap marker.
      4) Provide one cu ft 0.03 cu m pea gravel sump at outlet of each drain.
   c. Slope pipes under parking areas or driveways to drain outside these areas.
   d. Provide and install quick-coupling valve or valves in location for easy blowout of entire system. Install quick coupler valves with 4 lineal feet 1 200 mm minimum of Schedule 80 PVC pipe between valve and main line.

D. Installation of Pipe:
1. Install pipe in manner to provide for expansion and contraction as recommended by Manufacturer.
2. Unless otherwise indicated on Drawings, install main lines and lateral lines connecting pop-up rotor and impact sprinklers with minimum cover of 18 inches 450 mm based on finished grade. Install remaining lateral lines, including those connecting drip tubing, with minimum of 12 inches 300 mm of cover based on finish grade.
3. Install pipe and wires under driveways or parking areas in specified sleeves 18 inches 450 mm below finish grade or as shown on Drawings.
4. Locate no sprinkler head closer than 12 inches 300 mm from building foundation. Heads immediately adjacent to mow strips, walks, or curbs shall be one inch 25 mm below top of mow strip, walk, or curb and have one to 3 inches 75 mm clearance between head and mow strip, walk, or curb.
5. Cut plastic pipe square. Remove burrs at cut ends before installation so unobstructed flow will result.
6. Make solvent weld joints as follows:
   a. Do not make solvent weld joints if ambient temperature is below 35 deg F 2 deg C.
   b. Clean mating pipe and fitting with clean, dry cloth and apply one coat of P-70 primer to each.
   c. Apply uniform coat of 711 solvent to outside of pipe.
   d. Apply solvent to fitting in similar manner.
   e. Give pipe or fitting a quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
   f. Allow joints to set at least 24 hours before applying pressure to PVC pipe.
7. Tape threaded connections with teflon tape.

8. If pipe is larger than 3 inches 75 mm, install concrete thrust blocks wherever change of direction occurs on PVC main pressure lines.

E. Control Valves And Controller

1. Install valves in plastic boxes with reinforced heavy duty plastic covers. Locate valve boxes within 12 inches of sidewalks and shrub bed edges with tops at finish grade. Do not install more than two valves in single box.
2. Place 3 inches 5 mm minimum of pea gravel below bricks supporting valve boxes to drain box. Set valve boxes over valve so all parts of valve can be reached for service. Set cover of valve box even with finish grade. Valve box cavity shall be reasonably free from dirt and debris.
3. Wiring:
   a. Tape control wire to side of main line every 10 feet 3 000 mm. Where control wire leaves main or lateral line, enclose it in Class 200 PVC conduit.
   b. Use waterproof wire connectors at splices and locate all splices within valve boxes.
   c. Use white or gray color for common wire and other colors for all other wire. Each common wire may serve only one controller.
   d. Run one spare control wire from panel continuously from valve to valve throughout system similar to common wire for use as a replacement if a wire fails. Spare wire shall be different color than other wires, except use of green wire is not acceptable. Mark spare control wire in control box as an unconnected wire. Extend spare control wires 24 inches 600 mm and leave coiled in each valve box.

F. Backflow Preventer:

1. Install 24 inches 600 mm minimum from structures or hardscaping.
2. When installed adjacent to any structure, mount test cocks on side away from structure.
3. After installation, remove handles and turn over to Owner together with extra maintenance materials.

G. Sprinkler Heads:

1. Set sprinkler heads and quick-coupling valves perpendicular to finish grade.
2. Do not install sprinklers using side inlets. Install using base inlets only.
3. Set sprinkler heads at a consistent distance from existing walks, curbs, and other paved areas and to grade by using specified components or other method demonstrated in Pre-Construction Conference.

H. Drip Assembly:

1. Install pipe providing for expansion and contraction as recommended by Manufacturer.
2. Cut tubing square and remove burrs at cut ends.
3. Distribution tubing shall be between 14 inches 350 mm minimum and 48 inches 1200 mm maximum long. Layout PVC lateral lines as necessary to keep distribution tubing lengths within specified tolerances.
4. Locate drip emitter on uphill side of plant within rootball zone. Use (1) 6PH emitter on #1 plants, (1) 2 6PH emitter on #5 plants, (5) 2 6PH emitters on trees. Use no more than 5 emitters per lateral pipe connection.
5. Layout in-line tubing for trees as indicated on Drawings. Layout in-line tubing for shrubs and groundcovers so plants receive water within rootball zones.
6. Locate in-line tubing on top of soil but under bark mulch and filter fabric.
7. Staple in-line tubing to ground at 6 foot 1800 mm maximum intervals and within 12 inches 300 mm of ends and intersections.
8. Assembly Using Solvent Weld Joints:
   a. Do not make solvent weld joint if ambient temperature is below 35 deg F 2 deg C.
   b. Clean mating pipe and fitting with clean, dry cloth. Apply uniform coat of Weld-On PVC 721 solvent to outside of pipe and inside socket of fitting. Give joint quarter turn and make certain pipe is inserted to full depth of fitting socket.
   c. Allow joints to set 24 hours minimum before applying pressure to pipe.
9. Assembly Using 'Funny Pipe' Type Joints:
   a. Connect distribution tubing to lateral line using barbed ell fitting.
   b. Connect fitting to distribution tubing using straight barbed fitting with 1/2 inch 13 mm threaded end.

I. Before installation of sprinkler heads and drip emitters, open control valves and use full head of water to flush out system.

J. Arrange valve stations to operate in an easy-to-view progressive sequence around building. Tag valves with waterproof labels showing final sequence station assignments.

4.5 FIELD QUALITY CONTROL

A. Site Tests: Before backfilling main line, test pressure at 100 psi 690 kPA minimum for 2 hours minimum and make certain there are no leaks. Notify Architect 2 working days minimum before conducting test.

B. Inspections:
1. Architect's irrigation design consultant, or certified water auditor recommended by consultant and approved in writing by Architect, will review irrigation system before substantial completion.
2. Installations completed after water source has been turned off for season, as determined by Architect, will be accepted following spring, after system can be checked for proper operation.
3. Upon acceptance of irrigation system, reviewer will provide signed acceptance certificate to be included in Operations and Maintenance Manual. Certificate will include name and signature of reviewer, reviewer's company, date of review, and reviewer's telephone number.

4.6 ADJUSTING

A. Adjust sprinkler heads to proper grade when turf is sufficiently established to allow walking on it without appreciable harm. Such lowering and raising of sprinkler heads shall be part of original contract with no additional cost to Owner.

B. Adjust sprinkler heads for proper distribution and trim so spray does not fall on building.

C. Adjust watering time of valves to provide proper amounts of water to plants.

4.7 CLOSEOUT ACTIVITIES

A. Instruction of Owner:
1. After system is installed and approved, instruct Owner's designated personnel in complete operation and maintenance procedures.

END OF SECTION

SECTION 32 9001

COMMON PLANTING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Common procedures and requirements for landscaping work.
2. Provide maintenance for new landscaping as described in Contract Documents.

B. Related Requirements:
1. Section 32 0501: Common Earthwork Requirements.
2. Section 32 8423: Underground Sprinklers.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
1. Participate in pre-installation conference specified in Section 31 2213.
2. Schedule planting pre-installation conference after completion of Fine Grading specified in Section 31 2216, but before beginning landscape work. In addition to requirements of Section 01 3000:
   a. Establish responsibility for maintenance of new landscaping during all phases of construction period.
   b. Prepare two typical landscape planting excavations and conduct percolation test to verify that water drains away within two hours. Discuss results of percolation tests with Architect and Owner's representative.

1.3 SUBMITTALS

A. Closeout Submittals: At completion of landscape work, submit two copies of typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one full year after contract maintenance period ends.

1.4 QUALITY ASSURANCE

A. Qualifications:
1. Installers:
   a. Use trained personnel familiar with required planting procedures and with Contract Documents.
   b. Planting shall be performed under direction of foreman or supervisor with minimum five years experience in landscape installations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer. Protect materials from deterioration during delivery and while stored at site.

B. Deliver sod, plants, trees, and shrubs in healthy and vigorous condition and store in location on site where they will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers:
1. Erickson Landscape 801-301-2110.
2. Star Landscape 801-554-6005.
3. Turf Sprinklers 801-943-5055.

3.2 EXAMINATION

A. Inspect site and Contract Documents to become thoroughly acquainted with locations of irrigation, ground lighting, and utilities. Repair damage to these and other items adjacent to landscaping caused by work of this Section or replace at no additional cost to Owner.

3.3 PREPARATION

A. Before proceeding with work, verify dimensions and quantities. Report variations between Drawings and site to Architect before proceeding with landscape work.
1. Plant totals are for convenience of Contractor only and are not guaranteed. Verify amounts shown on Drawings.
2. All planting indicated on Drawings is required unless indicated otherwise.

B. Protection:
1. Take care in performing landscaping work to avoid conditions that will create hazards. Post signs or barriers as required.
2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
3. Keep site well drained and landscape excavations dry.

3.4 INSTALLATION

A. Interface With Other Work: Do not plant trees and shrubs until major construction operations are completed. Do not commence landscaping work until work of Sections 31 2216 and 32 8423 has been completed and approved.

B. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

C. Hand excavate as required.

D. Maintain grade stakes until parties concerned mutually agree upon removal.

E. When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify Architect before planting.

3.5 FIELD QUALITY CONTROL

A. Inspection:

1. Architect will inspect landscaping installation approximately two weeks before Substantial Completion. Replace landscaping that is dead or appears dead as directed by Architect within 10 days of notification and before Substantial Completion.

3.6 CLEANING

A. Immediately clean up soil or debris spilled onto pavement and dispose of deleterious materials.

3.7 CLOSEOUT ACTIVITIES

A. Replace damaged plantings at no additional cost to Owner.

3.8 PROTECTION

A. Protect planted areas against traffic or other use immediately after planting is completed by placing adequate warning signs and barricades.

B. Provide adequate protection of planted areas against trespassing, erosion, and damage of any kind. Remove this protection after Architect has accepted planted areas.

3.9 MAINTENANCE

A. General:
1. Before beginning maintenance period, plants shall be in at least as sound, healthy, vigorous, and in approved condition as when delivered to site, unless accepted by Architect in writing at final landscape inspection
2. Maintain landscaping from completion of landscape installation to 30 days after Substantial Completion Meeting. Areas sodded or seeded after November 1st will accepted following spring approximately one month after start of growing season, May 1st or as determined by Architect, if specified conditions have been met.
3. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Architect before end of maintenance period. Make replacements within 10 days of notification. Lawn that does not live and has to be replaced shall be guaranteed and maintained an additional 30 days from date of replacement.

B. Seeded Lawn:
1. Seeded lawn areas will not be accepted as complete and 30 day maintenance period will not begin until uniform stand of grass at least 3 inches 75 mm tall has been obtained.
2. After grass is established and 3 inches 75 mm tall, mow lawn areas at least weekly to a height of 2 inches 50 mm. During this period, perform work necessary to maintain a full, even stand of grass.
3. At end of 30 days of maintenance period, fertilize lawns as specified in Section 32 9113.
4. Apply weed killers as necessary in order to obtain weed free lawn. Apply weed killer in accordance with manufacturer's instructions during calm weather when air temperature is between 50 and 80 deg F 10 and 27 deg C.

C. Sodded Lawn:
1. Maintain sodded lawn areas until lawn complies with specified requirements and throughout maintenance period.
2. Water sodded areas in sufficient quantities and at required frequency to maintain sub-soil immediately under sod continuously moist 3 to 4 inches 75 to 100 mm deep.
3. Cut grass first time when it reaches 3 inches 75 mm high. Continue to mow at least once each week throughout maintenance period. Remove clippings.

4. Apply weed killer as necessary to maintain weed-free lawn. Apply weed killer in accordance with manufacturer's instructions during calm weather when air temperature is between 50 and 80 deg F 10 and 27 deg C.
5. At end of 30 day maintenance period, fertilize lawns as recommended in Section 32 9113.

D. Trees, Shrubs, And Plants:
1. Maintain by pruning, cultivating, and weeding as required for healthy growth.
2. Restore planting basins.
3. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical positions as required.
4. Spray as required to keep trees and shrubs free of insects and disease.
5. Provide supplemental water by hand as needed in addition to water from sprinkling system.

END OF SECTION

ATTACHMENTS FORMS: ***Following form should be given to the person or lab doing the testing each time a soils test is requested.*** **Not required for this project.**

PROJECT TOP SOIL TESTING FOR LANDSCAPE PURPOSES

DTA Area Office		
Ward/Branch		Date Requested: By Whom: Contact Phone # Fax #
City	State	
Stake/Mission		Property Number
Site Street Address		

Instructions to Architect

1. The architect is to determine, by investigation, the quality and quantity of topsoil on a site before the Owner's review. <u>All information on this form must be provided.</u>
2. A horticultural topsoil test is recommended at each site.
3. The tests should be performed by a reputable laboratory located in the vicinity of the property. Several acceptable alternatives are available for the testing:
   a. A geotechnical laboratory that does horticultural topsoil testing.
   b. A laboratory that specializes in horticultural topsoil testing.
4. The costs for the testing and report will be paid by the Owner.
5. Copies of the report shall be made available to the landscape architect, the DTA Area Office, and the landscape reviewing consultant.
6. Report location where soil is from and a history of its use on the back of this form.

Instructions to the Soil Testing Laboratory Firm

1. At least two test samples shall be made of the topsoil on the project site and each anticipated borrow pit. If the site soil profile or borrow pit are not uniform, additional samples shall be taken. Uniform composite samples may also be used if properly acquired and documented.

2. The soil report must provide interpretation and recommendations for soil amendments, fertilizers, and soil conditioners for use by the architect and the landscape architect.

Test Report on Existing Conditions ("Acceptable Levels" refers to the allowable Import Soil Specifications prior to amending.)

Soil Test Data

Sample No.	PH(1)	EC(1) Mmhos/cm	SAR(1)	% Sand	% Silt	% Clay	Text(2) Class	%(3) OM	NO_3-N(4) ppm	P(5) ppm	K(5) ppm	Fe(5) Ppm
Acceptable Level(s)	5.5-7.7	<2.0	<3.0	-	-	-	(2)	>1.0	>48	>11	>130	>5.0

Documented infiltration rate of test sample(s) based on texture at 90% relative density. *To the nearest 1/10 of an inch.

(1)saturated soil paste 1:1 soil:water method (please Indicate)
(2)hydrometer method
(Acceptable import soil-sand 15-60%, silt 10-60%, clay 5-30%)
(3)potassium dichromate method (Walkey-Black) or loss of ignition
(4)chromotropic acid method
(5)AB-DTPA method
--If other methods are used for NO_3-N, P, K, and Fe, then note.
Changes in acceptable levels shall also be made by the testing laboratory.

Sample No._____ _____-_____inches/hour*
Sample No._____ _____-_____inches/hour*
Sample No._____ _____-_____inches/hour*
Sample No._____ _____-_____inches/hour*

Name of Soil Lab

_____

Phone #_____Fax #_____

Interpretation Statement:

Soil Amendment, Fertilizer and Soil Conditioner – Recommendations:

Long Term (5 Year) Fertilizer and Soil Conditioner – Recommendations:

SECTION 32 9113

SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Perform soil preparation work as described in Contract Documents.
2. Furnish and apply soil additives as described in Contract Documents.

1.2 REFERENCES

A. Reference Standards:
1. ASTM International:
   a. ASTM 1557-02, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.'

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 31 2213.

1.4 SUBMITTALS

A. Action Submittals:
1. Product Data: Product literature and chemical / nutrient analysis of soil amendments and fertilizers.
2. Samples: Sample of soil conditioner for approval before delivery to site. Include product analysis list.

B. Informational Submittals:
1. Installer Reports: Delivery slips indicating amount of soil conditioner delivered to Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Incorporate following soil amendments into topsoil used for Project. Do not apply additional fertilizer if GroPower Plus soil conditioner is used.
1. Acceptable Soil Amendments, Soil Conditioners, And Application Rates:
   a. EPA Class 'A' co-compost or compost with SAR less than 3.0, EC less than 4.0, and CN ratio of 15 to 25:1 passing through 1/2 inch mesh screen.
   b. Equals as approved by Architect before use. See Section 01 6200.
2. Acceptable Fertilizers And Application Rates:
   a. 2.8 lbs of 4100 s.f.
   b. 1.4 lbs of p205/1000 s.f.
   c. Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Add specified soil amendments at specified rates to lawn areas. Roto-till or otherwise mix amendments evenly into top 4 inches 100 mm of topsoil. Incorporate and leach soil amendments which require leaching, such as gypsum, within such time limits that soil is sufficiently dry to allow proper application of fertilizer and soil conditioners.

END OF SECTION

SECTION 32 9120

TOPSOIL PLACEMENT AND GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Perform topsoil placement and grading work required to prepare site for installation of landscaping as described in Contract Documents.
2. Furnish and apply soil additives as described in Contract Documents.

B. Related Requirements:
1. Section 31 1413: Stripping and storing of existing topsoil.

1.2 REFERENCES

A. Reference Standards:
1. ASTM International:
   a. ASTM 1557-02, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.'

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 31 2213.

1.4 SUBMITTALS

A. Action Submittals:
1. Product Data: Product literature and chemical / nutrient analysis of soil amendments and fertilizers.
2. Samples: Sample of soil conditioner for approval before delivery to site. Include product analysis list.

B. Informational Submittals:
1. Field Quality Control Submittals:
   a. Submit tests on imported and site topsoil by licensed laboratory before use, using Owner Form 'Topsoil Test Report.'
      1) Before use, topsoil shall meet minimum specified requirements and be approved by Architect.
      2) If necessary, submit proposed amendments and application rates necessary to bring topsoil up to minimum specified requirements.
   b. Submit report stating location of source of imported topsoil and account of recent use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. Topsoil used in landscaped areas, whether imported or from site, shall be fertile, loose, friable soil meeting following criteria:
   a. Chemical Characteristics:
      1) Acidity / alkalinity range: pH 5.5 to 8.0.
      2) Soluble Salts: less than 3.0 mmhos/cm.
      3) Sodium Absorption Ratio (SAR): less than 6.0.
      4) Organic Matter: greater than one percent.
   b. Physical Characteristics:
      1) Gradation as defined by USDA triangle of physical characteristics as measured by hydrometer.
         a) Sand: 15 to 60 percent.
         b) Silt: 10 to 60 percent.
         c) Clay: 5 to 30 percent.
      2) Clean and free from toxic minerals and chemicals, noxious weeds, rocks larger than 1-1/2 inch 38 mm in any dimension, and other objectionable materials.
      3) Soil shall not contain more than 2 percent by volume of rocks measuring over 3/32 inch 2 mm in largest size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not commence work of this Section until grading tolerances specified in Section 31 2216 are met.

3.2 PREPARATION

A. Protection Of In-Place Conditions: Protect utilities and site elements from damage.

B. Surface Preparation:
1. Disk, till, or aerate with approved agricultural aerator to depth of 6 inches 150 mm.
2. Seven days maximum before beginning seeding and planting:
   a. Loosen area 4 inches 100 mm deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
   b. Rake area to remove clods, rocks, weeds, roots, and debris.
   c. Grade and shape landscape area to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.
3. Limit use of heavy equipment to areas no closer than 6 feet 1800 mm from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer then 6 feet 1800 mm.

3.3 PERFORMANCE

A. Tolerances:
1. Total topsoil depth of 5 inches 125 mm minimum in lawn and groundcover planting areas. No topsoil as defined in this Section required over tree and shrub planting areas.
2. Finish grade of planting areas before planting and after addition of soil additives shall be specified distances below top of adjacent pavement of any kind:
   a. Sodded Areas: 2 inches 50 mm below.
   b. Shrub Areas: 4 inches 100 mm below

B. Do not expose or damage existing shrub or tree roots.

C. Redistribute approved existing topsoil stored on site as a result of work of Section 31 1413. Remove organic material, rocks and clods greater than 1-1/2 inch 38 mm in any dimension, and other

objectionable materials. Provide additional approved imported topsoil required to bring surface to specified elevation relative to concrete site elements. Do not place topsoil whose moisture content makes it prone to compaction during placement process.

D. Slope grade away from building for 12 feet 3600 mm minimum from walls at slope of 1/2 inch in 12 inches 13 mm in 300 mm minimum unless otherwise noted. High point of finish grade at building foundation shall be 6 inches 150 mm minimum below finish floor level. Direct surface drainage in manner indicated on Drawings by molding surface to facilitate natural run-off of water. Fill low spots and pockets with topsoil and grade to drain properly.

E. After landscape areas have been prepared, take no heavy objects over them except lawn rollers. Immediately before planting lawn and with topsoil in semi-dry condition, roll areas that are to receive lawn in two directions at approximately right angles with water ballast roller weighing 100 to 300 lbs 45 to 135 kg, depending on soil type. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.

END OF SECTION

SECTION 32 9222

HYDRO-SEEDING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Furnish and install hydro-seeded specialty seed mixes as described in Contract Documents.

1.2 SUBMITTALS

A. Informational Submittals:
1. Source Quality Control Submittals: Written certification from supplier confirming seed mix, guaranteed analysis, germination rate, and purity rate.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Chemicals used shall meet requirements of latest rules and regulations, and other applicable state or local laws. Nothing in Contract Documents is to be construed to permit use of chemicals not conforming to these codes.
2. Label seed in accordance with USDA rules and regulations under Federal Seed Act.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Supply wood cellulose fiber mulch compressed in 50 lb packages.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Seed:
1. Type and mix shown on Drawings.
2. Provide three varieties minimum – See plans for seed mix.
3. Seed shall be weed free, fresh, re-cleaned, Grade A, new crop.

B. Hydro-Mulch:
1. Cellulose wood fiber with no growth or germination inhibiting factors, dyed green. Material shall have equilibrium air-dry moisture content of 12 percent, plus or minus 2 percent, at time of manufacture.
2. Fiber shall disperse rapidly in water forming homogeneous slurry and remaining in such state when agitated in hydro-mulching equipment.
3. Quality Standard: SoilGuard by Mat Inc, Floodwood, MN www.matinc.biz.

C. Binders:
1. Tackifier to bind soil and mulch together to prevent erosion.
2. Type Two Acceptable Products:
   a. Am-Tac by AZ-TAC Products Inc,
   b. Soil Seal by Trans Western Chemicals Inc, Pico Rivera, CA www.soilseal.com.

c. Equal as approved by Architect before use. See Section 01 6200.

D. Fungicide:
1. Type Two Acceptable Products:
a. Banol by Nor-Am Chemical Co.
b. Equal as approved by Architect before use. See Section 01 6200.

E. Post-Emergent Weed Control:
1. Type Two Acceptable Products:
a. Enide by Upjohn.
b. Dymid by Elanco.
c. Treflan or Surflan by Dow Agrosciences.
d. Eptan by Syngenta.
e. Equal as approved by Architect before use. See Section 01 6200.

F. Fertilizer: 16-20-0.

2.2 MIXES

A. Slope Stabilization Seeded Areas:
1. Amount of seed shall be **8 lbs sq ft**
2. Add fertilizer at 10 lbs per 1000 sq ft.
3. Add binder at rates recommended by Manufacturer always on slopes 5:1 and over.

PART 3 - EXECUTION

3.1 APPLICATION

A. Interface With Other Work: Do not commence work of this Section until work of Sections 32 9113 and 32 9300 has been completed and approved.

B. Tolerances: Final grade of soil after seeding areas is complete shall be one inch 25 mm below top of adjacent pavement of any kind.

C. After areas are graded, apply specified slurry mix with machine capable of continuously mixing slurry and providing an application meeting Contract Document requirements. Hydro-mulch shall form an absorptive mat, but not a plant inhibiting membrane, which will allow water to percolate into underlying soil.

D. Post Application Watering:
1. Allow slurry mixture to 'set.'
2. Water hydro-seeded areas sufficiently to insure proper seed germination, but not cause erosion or slope failure. Repeat watering at regular intervals to keep seed germinating and growing until plantings are established.
3. After plantings are established, decrease frequency and increase amount of water per application as necessary to meet plant water requirements.

E. If fungicide has been applied with slurry mix, make a second application of fungicide 14 days after initial application.

3.2 FIELD QUALITY CONTROL

A. Inspection:
1. Seeded areas will be accepted at final inspection if:
a. Seeded areas are properly established.

END OF SECTION

SECTION 32 9300

PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Furnish and install landscaping plants as described in Contract Documents.

B. Related Requirements:
1. Section 32 9001: Common Planting Requirements.

1.2 REFERENCES

A. Reference Standards:
1. American Nursery & Landscape Association / American National Standards Institute:
   a. ANLA / ANSI Z60.1-2004, 'American Standard for Nursery Stock.'

1.3 SUBMITTALS

A. Action Submittals:
1. Samples: Top dressing mulch for approval before delivery to site.

B. Closeout Submittals:
1. Installer Instructions: Provide written instructions covering maintenance requirements by Owner for one year beyond Contract maintenance period specified in Section 32 0101. Include in Operations And Maintenance Manual specified in Section 01 7800.
2. Warranty Documentation: Include final, executed copy of warranty in Operations And Maintenance Manual specified in Section 01 7800.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
1. Deliver trees after preparations for planting have been completed and install immediately.
2. Do not prune before delivery, except as approved by Architect.
3. Protect bark, branches, and root systems from sun scald, drying, whipping, and other handling and tying damage.
4. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape.
5. Provide protective covering during delivery.

B. Storage And Handling Requirements;
1. Handle balled stock by root ball or container. Do not drop trees during delivery.
2. If planting is delayed more than six hours after delivery, set planting materials in shade and protect from weather and mechanical damage.
3. Set balled stock on ground and cover ball with soil, saw dust, or other acceptable material approved by Architect. Do not place on pavement.
4. Do not remove container-grown stock from containers before time of planting.
5. Water root systems of trees and shrubs stored on site with fine spray. Water as often as necessary to maintain root systems in moist condition. Do not allow plant foliage to dry out.

1.5 WARRANTY

A. Provide written warranties as follows:
   1. Guarantee trees to live and remain in strong, vigorous, and healthy condition for one year from date landscape installation is accepted as complete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Plants:
   1. Conform to requirements of Plant List and Key on Drawings and to ANSI Z60.1.
   2. Nomenclature: Plant names used in Plant List conform to 'Standardized Plant Names' by American Joint Committee on Horticultural Nomenclature except in cases not covered. In these instances, follow custom of nursery trade. Plants shall bear a tag showing the genus, species, and variety of at least 10 percent of each species delivered to site.
   3. Quality:
      a. Plants shall be sound, healthy, vigorous, free from plant disease, insect pests or their eggs, noxious weeds, and have healthy, normal root systems. Container stock shall be well established and free of excessive root-bound conditions.
      b. Do not prune plants or top trees prior to delivery.
      c. Plant materials shall be subject to approval by Architect as to size, health, quality, and character.
      d. Bare root trees are not acceptable.
      e. Provide plant materials from licensed nursery or grower.
   4. Measurements:
      a. Measure height and spread of specimen plant materials with branches in their normal position as indicated on Drawings or Plant List.
      b. Measurement should be average of plant, not greatest diameter. For example, plant measuring 15 inches 375 mm in widest direction and 9 inches 225 mm in narrowest would be classified as 12 inch 300 mm stock.
      c. Plants properly trimmed and transplanted should measure same in every direction.
      d. Measure caliper of trees 6 inches 150 mm above surface of ground.
      e. Where caliper or other dimensions of plant materials are omitted from Plant List, plant materials shall be normal stock for type listed.
      f. Plant materials larger than those specified may be supplied, with prior written approval of Architect, and:
         1) If complying with Contract Document requirements in all other respects.
         2) If at no additional cost to Owner.
         3) If sizes of roots or balls are increased proportionately.
   5. Shape and Form:
      a. Plant materials shall be symmetrical or typical for variety and species and conform to measurements specified in Plant List.
      b. Well grown material will generally have height equal to or greater than spread. However, spread shall not be less than 2/3's of height.

2.2 ACCESSORY PRODUCTS

A. Planting Mix: Mixture of three parts topsoil mix as specified in Section 32 9113 and one part well rotted composted manure, or approved commercial mix.

B. Planting Tablets: 21 gram Agriform 20-10-5.

C. Tree Stakes:
   1. Type Two Acceptable Products:
      a. 2 inch 50 mm diameter Lodgepole Pine.

b. Equal as approved by Architect before installation. See Section 01 6200.

D. Tree Staking Ties:
1. Type Two Acceptable Products:
a. 32 inch 800 mm Cinch-Tie tree ties by V.I.T. Products Inc, Escondido, CA www.vitproducts.com.
b. Flex strap Tree Ties by Aquarius Brands Inc, Ontario, CA www.aquariusbrands.com.
c. Equal as approved by Architect before installation. See Section 01 6200.

E. Tree Guys:
1. Type Two Acceptable Products:
a. Duckbill Model 68DTS guying kit.
b. Equal as approved by Architect before installation. See Section 01 6200.

F. Pre-Emergent Herbicide:
1. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a. Chipco Dimension Granular by The Andersons Inc, Maumee, IL www.andersonsinc.com.
b. Elanco XL2G granular by Crop Data Management Systems, Marysville, CA www.cdms.net.
c. Ronstar G granular by Bayer Crop Science, Monheim, Germany www.bayercropscience.com.
d. Surflan AS liquid by United Phosphorous Inc, Trenton, NJ www.upi-usa.com.
e. Oryzalin 4 A.S. liquid by FarmSaver, Seattle, WA www.farmsaver.com.

G. Rock Mulch:
1. Type Two Acceptable Products:
a. See plans.
b. Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before proceeding with work, check and verify dimensions and quantities. Report variations between Drawings and site to Architect before proceeding with work of this Section.

B. Plant totals are for convenience only and are not guaranteed. Verify amounts shown on Drawings. All planting indicated on Drawings is required unless indicated otherwise.

3.2 PREPARATION

A. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas. Secure Architect's acceptance before planting. Make minor adjustments as may be requested.

3.3 INSTALLATION

A. Interface With Other Work: Do not commence work of this Section until work of Section 32 9113 has been completed and approved.

B. Excavation:
1. If underground construction work or obstructions are encountered in excavation of planting holes, Architect will select alternate locations.
2. Plant Excavation Size:
a. Diameter: Twice diameter of root ball or container minimum.
b. Depth: Equal to container or rootball depth.

3. Unless excavated material meets topsoil requirements as specified in Section 31 9113, remove from landscape areas and do not use for landscaping purposes.
4. Roughen sides and bottoms of excavations.
5. With approval of Architect, select five typical planting excavations throughout site for drainage testing.
   a. Fill selected excavations with water and verify that water drains away at rate of 3 inches 75 mm per hour minimum. Inform Architect in writing of excavations where water does not drain properly.
   b. Select three excavations approximately 5 feet away from each non-draining excavation and repeat tests. Continue testing process until non-draining areas have been identified.
   c. In excavations located in identified non-draining areas, auger 6 inch 150 mm diameter hole 4 feet 1 200 mm deep in low point of each excavation and fill with tamped planting mix.
   d. Do not plant trees or shrubs in holes that do not properly drain.

C. Planting:
1. Removing Binders And Containers:
   a. Remove top one / third of wire basket and burlap binders.
   b. Remove plastic and twine binders from around root ball and tree trunk.
   c. Remove wood boxes from around root ball. Remove box bottoms before positioning plant in hole. After plant is partially planted, remove remainder of box without injuring root ball.
2. Plant immediately after removing binding material and containers. Place tree rootballs on undisturbed soil. After watering and settling, top of tree root balls shall be approximately two inches 50 mm higher than finished grade and trunk flare is visible. Shrub root balls shall be approximately one inch 25 mm higher than finished grade
3. Properly cut off broken or frayed roots.
4. Center plant in hole, remove remaining wire basket, and backfill with specified planting mix. Except in heavy clay soils, make ring of mounded soil around hole perimeter to form watering basin.
5. Add planting tablets in plant pit as follows. Place tablets in relation to root ball as recommended by Manufacturer.
   a. One Gallon 4.5 L Shrub: 1 tablet.
   b. 5 Gallon 23 L Shrub / Tree: 3 tablets.
   c. 15 Gallon 68 L Tree: 4 tablets.
   d. 24 inch600 mm Box Tree: 6 Tablets.
6. Fill landscape excavations tamped planting mix. Settle by firming and watering to ensure top of ball one inch higher than surrounding soil.
7. Do not use muddy soil for backfilling.
8. Make adjustments in positions of plants as directed by Architect.
9. Thoroughly water trees and shrubs immediately after planting.
10. At base of each tree, leave 36 inch 900 mm diameter circle free of any grass.

D. Supports for New Trees:
1. Provide new supports for trees noted on Drawings to be staked.
   a. Remove nursery stakes delivered with and attached to trees.
   b. Support shall consist of at least two tree stakes driven into hole base before backfill so roots are not damaged. Place stakes vertically and run parallel to tree trunk. Install stakes so 3 feet 900 mm of stake length is below finish grade.
   c. Place tree ties 6 to 12 inches 150 to 300 mm below crotch of main tree canopy. Second set of tree ties may be required 18 to 24 inches 450 to 600 mm above finish grade, if directed by Architect.
   d. Remove tops of tree stakes so top of stake is 6 inches 150 mm below main tree canopy to prevent damage to tree branches and canopy growth.
2. Provide root guying kits to support 24 inch 600 mm box, 3 inch 75 mm caliper and larger trees.

E. Post Planting Weed Control:
1. Apply specified pre-emergent herbicide to shrub and ground cover planting areas and grass-free areas at tree bases after completion of planting.
2. Areas shall be free of existing weed growth before application of herbicide.

F. Weed Barrier Fabric:

1. After planting and application or herbicide in shrub beds, apply covering of specified weed barrier fabric.
2. Achieve 100 percent coverage over ground areas.
3. Overlap seams 6 inches 150 mm minimum.
4. Staple at 5 feet 1500 mm on center each way and within 3 inches 75 mm of edge of shrub bed, with two at each corner.

G. Mulching:
1. After application of herbicide, mulch shrub and ground cover planting areas with 3 inches 75 mm deep layer of specified top dressing or rock mulch.
2. Cover grass-free area at tree bases with weed barrier and 3 inches 75 mm of top dressing mulch or rock mulch.
3. Place mulch to uniform depth and rake to neat finished appearance.

END OF SECTION

SECTION 32 9413

LANDSCAPE EDGING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Furnish and install landscape edging and headers as described in Contract Documents.

B. Related Requirements:
1. Section 03 3053: Concrete mow strips.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Edging And Headers:
1. 3/16 inch 5 mm thick steel headers. Shop primed and finish painted in color selected by Architect from Manufacturer's standard colors.
2. Type Two Acceptable Products:
   a. Border Guard by Border Concepts, Charlotte, NC www.borderconcepts.com.
   b. Ryerson Steel Edging.
   c. Any metal fabricator or manufacturer providing material meeting specified requirements as approved by Architect before installation. See Section 01 6200.
3. Stakes: No. 4 rebar 12 inches 300 mm long or Manufacturer's steel stakes.

B. Wood Edging And Headers:
1. Headers And Stakes: No. 1 common grade rough Redwood or Cedar.
2. Nails: Aluminum or hot dip galvanized box nails.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Metal Edging And Headers:
1. Extend headers one inch 25 mm above grade and hold in place with specified stakes extending into solid earth full length. Set top of stakes 1/2 inch 13 mm below top of header.
2. Attach stake to header by arc welding both sides of stake to header. Attach sections of header by overlapping 4 inches 100 mm and arc welding.

B. Wood Edging And Headers:
1. Provide 2x6 38 by 140 mm headers (or two pieces 1x6 19 by 140 mm laminated where curve is shown) to separate lawn areas from planting areas unless shown otherwise on Drawings.
2. Extend headers 1/2 inch 13 mm above grade and hold in place with 1x2 19 by 38 mm stakes of length necessary to extend into solid earth 12 inches 300 mm minimum. Stakes shall be of sound material, neatly pointed, driven vertically, and securely nailed to headers. Space stakes not to exceed 4 feet 1 200 mm on center. Set top of stakes 1/2 inch 13 mm below top of header and cut at angle to slope away from header top.

C. Compact backfill on both sides of headers to density of undisturbed adjoining earth.

END OF SECTION

DIVISION 33: UTILITIES

33 1000 WATER UTILITIES

33 1116 DOMESTIC WATER PIPING

33 3000 SANITARY SEWERAGE UTILITIES

33 3313 FACILITY SANITARY SEWERS

33 4000 STORM DRAINAGE UTILITIES

33 4116 SITE STORM UTILITY DRAINAGE PIPING

END OF TABLE OF CONTENTS

SECTION 33 1116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Perform excavating and backfilling required by work of this Section.
2. Furnish and install potable water piping complete with necessary valves, connections, and accessories inside building and connect with outside utility lines 5 feet 1 500 mm from building perimeter as described in Contract Documents.

B. Related Requirements:
1. Section 22 0501: Common Piping Requirements.
2. Section 22 0583: Plumbing Piping Insulation.
3. Section 31 2316: Criteria for performance of excavation.
4. Section 31 2323: Criteria for performance of backfill.
5. Section 33 1116: Domestic water piping from 5 feet 1 500 mm from building perimeter to main.

1.2 REFERENCES

A. Reference Standards:
1. ASTM International:
   a. ASTM B 88-03, 'Standard Specification for Seamless Copper Water Tube.'

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 03 3111.

1.4 SUBMITTALS

A. Action Submittals:
1. Product Data: Manufacturer's literature on PEX pipe and PEX pipe fittings.
2. Sample: PEX pipe fitting.

B. Informational Submittals:
1. Test And Evaluation Reports: Written report of sterilization test.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
1. Manufacturer List:
   a. Armstrong International Inc, Three Rivers, MI www.armstrong-intl.com.
   b. Bell & Gossett, Morton Grove, IL www.bellgossett.com.
   c. Cash Acme, Cullman, AL www.cashacme.com
   d. Cla-Val Company, Costa Mesa, CA www.cla-val.com.

e. Conbraco Industries Inc, Matthews, NC www.conbraco.com.
f. Hammond Valve, New Berlin, WI www.hammondvalve.com.
g. Handy & Harmon Products Div, Fairfield, CT www.handyharmon.com.
h. Harris Products Group, Cincinnati, OH www.harrisproductsgroup.com.
i. Jenkins Valves Inc, Brantford, ON www.cranevalve.com.
j. Leonard Valve Co, Cranston, RI www.leonardvalve.com.
k. Milwaukee Valve Co, New Berlin, WI www.milwaukeevalve.com.
l. Mueller Co, Decatur, IL www.muellerflo.com.
m. Nibco Inc, Elkhart, IN www.nibco.com.
n. PowersControls, Buffalo Grove, IL www.powerscontrols.com.
o. Rehau, Leesburg, VA www.rehau-na.com.
p. Sloan Valve Co, Franklin Park, IL www.sloanvalve.com.
q. Spence Engineering Co, Walden, NY www.spenceengineering.com.
r. Stockham Valves, Cullman, AL www.stockham.com.
s. Symmons Industries, Braintree, MA www.symmons.com.
t. Taco Inc, Cranston, RI www.taco-hvac.com.
u. Uponor Inc, Apple Valley, MN www.uponor-usa.com.
v. Viega ProPress, Wichita, KS www.viega-na.com.
w. Watts Regulator Co, Andover, MA www.wattsreg.com.
x. Wilkins Operation, Paso Robles, CA www.zurn.com.

B. Materials
1. Pipe:
a. Copper:
1) Above-Grade: Meet requirements of ASTM B 88, Type L.
2) Below-Grade:
a) Meet requirements of ASTM B 88, Type K. 3/4 inch 19 mm minimum under slabs.
b) 2 inches 50 mm And Smaller: Annealed soft drawn.
c) 2-1/2 inches 63 mm And Larger: Hard Drawn.
b. Cross-Linked Polyethylene (PEX):
1) Certified with NSF International against NSF Standards 14 and 61 and NSF Protocol 171.
2) Copper tube size (CTS) outside dimensions and Standard Dimension Ratio (SDR) of 9.
3) Pressure rated for 160 psi at 73 deg F, 100 psi at 180 deg F, and 80 psi at 200 deg F.
4) Marked with Manufacturer's name, design pressure and temperature ratings, and third party certification stamp for NSF-PW.
5) Manufactured by Engel or peroxide method (PEX-A) or by silane method (PEX-B).
6) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Raupex by Rehau.
b) Wirsbo Aquapex by Uponor.
c) ViegaPEX by Viega.
2. Fittings:
a. For Copper Pipe: Wrought copper.
b. For PEX Pipe:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
a) Everloc by Rehau.
b) Propex by Uponor including EP flow-through multiport tees.
c) F877 bronze fitting with stainless steel press sleeve by Viega.
3. Connections For Copper Pipe:
a. Above-Grade:
1) Sweat copper type with 95/5 or 96/4 Tin-Antimony solder, Bridgit solder, or Silvabrite 100 solder. Use only lead-free solder.
2) Viega ProPress System
b. Below Grade:
1) Brazed using following type rods:
a) Copper to Copper Connections:
(1) AWS Classification BCuP-4 Copper Phosphorus (6 percent silver).

(2) AWS Classification BCuP-5 Copper Phosphorus (15 percent silver).

2) Copper to Brass or Copper to Steel Connections: AWS Classification BAg-5 Silver (45 percent silver).
3) Do not use rods containing Cadmium.
4) Brazing Flux:
   a) Approved Products:
      (1) Stay-Silv white brazing flux by Harris Product Group.
      (2) High quality silver solder flux by Handy & Harmon.
5) Joints under slabs acceptable only if allowed by local codes.

4. Ball Valves:
   a. Use ball valves exclusively unless otherwise specified. Ball valves shall be by single manufacturer from approved list below.
   b. Valves shall be two-piece, full port for 150 PSI SWP.
      1) Operate with flow in either direction, suitable for throttling and tight shut-off. Full port, three-piece maintenance design.
      2) Body: Bronze, 150 psig wsp at 350 deg F and 400 psig wog.
      3) Seat: Bubble tight at 100 psig under water.
   c. Class One Quality Standard: Nibco T585 or S585.
      1) Equal by Conbraco 'Apollo,' Hammond, Milwaukee, or Watts.
5. Combination Pressure Reducing Valve / Strainer:
   a. Integral stainless steel strainer, or separate 'Y' strainer installed upstream of pressure reducing valve.
   b. Built-in thermal expansion bypass check valve.
   c. Class One Quality Standard: Watts U5B.
      1) Equal by Cash Acme, Cla-Val Hi Capacity, Conbraco 36C, Honeywell-Braukmann, Spence Hi Capacity, Watts, or Wilkins. See Section 01 6200.
6. Mixing Valves:
   a. Solid brass construction and CSA B125 certified.
   b. Includes integral check valves and inlet screen. Features advanced paraffin-based actuation technology.
   c. Flow of 11 GPM with maximum 10 psi pressure drop. Perform to minimum flow of 0.5 GPM in accordance with ASSE 1017-2003.
   d. Set for 110 deg F 43 deg C Service.
   e. Class One Quality Standard: Powers LM491-10. See Section 01 6200.
   f. Acceptable Manufacturers: Leonard, Powers, Sloan, Symmons, and Watts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Below Grade:
   1. Install piping under slabs without joints where possible.
   2. Insulate water piping buried within building perimeter.
   3. Bury water piping 6 inches 150 mm minimum below bottom of slab and encase in 2 inches 50 mm minimum of sand.

B. Locate cold water lines a minimum of 6 inches 150 mm from hot water line.

3.2 FIELD QUALITY CONTROL

A. Field Tests: Before pipes are covered, test systems in presence of Architect at 125 psi 862 kPa hydrostatic pressure for 4 hours and show no leaks. Disconnect equipment not suitable for 125 psig 862 kPa pressure from piping system during test period.

3.3 CLEANING

A. Sterilize potable water system with solution containing 200 parts per million minimum of available chlorine and maintaining pH of 7.5 minimum. Introduce chlorinating materials into system in manner approved by Architect. Allow sterilization solution to remain for 24 hours and open and close valves and faucets several times during that time.

B. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.

C. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.

END OF SECTION

SECTION 33 3313

FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Furnish and install soil, waste, and vent piping systems within building and connect with outside utility lines 5 feet 1 500 mm out from building where applicable.
2. Perform excavation and backfill required by work of this Section.

B. Related Requirements:
1. Sections Under 07 3000 Heading: Furnishing and installing of roof jacks and pipe flashing at roof.
2. Section 07 8400: Quality of firestopping material.
3. Section 22 0501: Common Plumbing Requirements.
4. Section 31 2316: Criteria for performance of excavation.
5. Section 31 2323: Criteria for performance of backfill.
6. Section 33 3313: Sewage piping from 5 feet 1 500 mm out from building to main.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 03 3111.

1.3 REFERENCES

A. Reference Standards:
1. ASTM International:
   a. ASTM A 74-05, 'Standard Specification for Cast Iron Soil Pipe and Fittings.'
   b. ASTM C 564-03a, 'Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.'
   c. ASTM D 2235-94, 'Standard Specification for Solvent Cement for ABS Plastic Pipe and Fittings.'
   d. ASTM D 2321-05, 'Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.'
   e. ASTM D 2564-02, 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride)(PVC) Plastic Piping Systems.'
   f. ASTM D 3034-04a, 'Standard Specification for Type PSM Poly Vinyl Chloride)(PVC) Sewer Pipe and Fittings.'
   g. ASTM F 628-01, 'Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings with a Cellular Core.'
   h. ASTM F 656-02, 'Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride)(PVC) Plastic Pipe and Fittings.'
   i. ASTM F 891-04, 'Standard Specification for Coextruded Poly (Vinyl Chloride)(PVC) Plastic Pipe with a Cellular Core.'

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
1. Manufacturer List:
   a. American Brass & Iron (AB&I), Oakland, CA www.abifoundry.com.
   b. Clamp-All Corp, Haverhill, MA www.clampall.com.
   c. Anaco-Husky, Corona, CA www.anaco-husky.com.
   d. Josam Co, Michigan City, IN www.josam.com.
   e. Jay R. Smith Manufacturing Co, Montgomery, AL www.jrsmith.com.
   f. MG Piping Products Co, Stanton, CA www.mgcoupling.com.
   g. Mifab Manufacturing Inc, Chicago, IL www.mifab.com.
   h. Wade Div Tyler Pipe, Tyler, TX www.wadedrains.com.
   i. Zurn Cast Metal, Erie, PA, CT www.zurn.com.

B. Performance:
1. Design Criteria:
   a. Minimum size of waste piping installed under floor slab on grade shall be 2 inches 50 mm.

C. Materials:
1. Piping And Fittings: PVC Schedule 40 cellular core plastic pipe and pipe fittings meeting requirements of ASTM F 891, joined using cement primer meeting requirements of ASTM F 656 and pipe cement meeting requirements of ASTM D 2564.
2. Piping And Fittings: ABS Schedule 40 cellular core plastic pipe and pipe fittings meeting requirements of ASTM F 628, joined with pipe cement meeting requirements of ASTM 2235.
3. Buried Piping:
   a. Approved Types: Per plans.

   b. Joint Material:
      1) Single-Hub: Rubber gaskets meeting requirements of ASTM C 564.
      2) No-Hub:
         a) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
         b) SuperGrip 304 American Brass & Iron (AB&I).
         c) Husky SD 4000 coupling by Anaco.
         d) Neoprene gaskets with type 304 stainless steel clamp and 24 ga type 304 stainless steel housing by Clamp-All Corp.
         e) MG Coupling by MG Piping Products.
4. Above Grade Piping And Vent Lines:
   a. Approved Types:
      1) Service weight, single-hub or no-hub type cast iron soil pipe meeting requirements of ASTM A 74.
      2) Vent lines 2-1/2 inches 63 mm or smaller may be Schedule 40 galvanized steel.
   b. Joint Material:
      1) Single-Hub: Rubber gaskets meeting requirements of ASTM C 564.
      2) No-Hub Pipe: Neoprene gaskets with stainless steel cinch bands.
5. Fittings:
   a. Cast Iron Pipe: Hub and spigot, except fittings for no-hub pipe shall be no-hub, and meet requirements of ASTM A 74.
      1) Joint Material: Rubber gaskets meeting requirements of ASTM C 564.
      2) Galvanized Pipe: Screwed Durham tarred drainage type.
   b. Traps installed on cast iron bell and spigot pipe shall be service weight cast iron. Traps installed on threaded pipe shall be recess drainage pattern type.
   c. P-Traps:
      1) Trap shall have clean out plug if installed in other than slab on grade.
      2) Type Two Acceptable Products.
         a) 7220 deep seal cast iron by JR Smith

b) Zurn Z-1000 by Zurn Industries.
c) Equal as approved by Architect before installation. See Section 01 6200.

6. Cleanouts:
   a. Furnish wall cleanouts with chrome wall cover and screw.
   b. Type Two Acceptable Products:
      1) Finish Floors:
         a) Josam: 56010.
         b) J. R. Smith: 4023.
         c) Mifab: C1100C-R-1.
         d) Wade: W-6000.
         e) Zurn: Z-1402.
      2) Resilient Flooring:
         a) Josam: 56010-12.
         b) J. R. Smith: 4140.
         c) Mifab: C1100C-T-1.
         d) Wade: W-6000-T.
         e) Zurn: Z-1400.
      3) Finished Wall:
         a) Josam: 58790.
         b) J. R. Smith: 4530.
         c) Mifab: C1460RD.
         d) Wade: W8560E.
         e) Zurn: Z-1446.
      4) Exposed Drain Lines:
         a) Josam: 58910.
         b) J. R. Smith: 4510.
         c) Mifab: C1460.
         d) Wade: W8560B.
         e) Zurn: Z-1440.
      5) General Purpose:
         a) Josam: 58900.
         b) J. R. Smith: 4400.
         c) Mifab: C1300-MF
         d) Wade: W8550E.
         e) Zurn: Z-1440.
      6) Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Drawings.
   2. Excavate to required depth and grade to obtain fall required. Grade soil and waste lines within building perimeter 1/4 inch 6 mm fall in one foot 300 mm in direction of flow.
   3. Bottom of trenches shall be hard. Tamp as required.
   4. Remove debris from trench before laying of pipe.
   5. Do not cut trenches near footings without consulting Architect.

B. Metal Pipe And Fittings:
   1. Provide depression under bell of each joint to maintain even bearing of sewer pipe.
   2. Connect to street main as required by local authorities.
   3. Use jacks to make-up gasketed joints.
   4. Do not calk threaded work.
   5. Use torque wrench to obtain proper tension in cinch bands when using hubless cast iron pipe. Butt ends of pipe against centering flange of coupling.

C. Thermoplastic Pipe And Fittings:
1. General: Piping and joints shall be clean and installed according to Manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
2. Above Grade: Locate pipe hangers every 4 feet 1 200 mm on center maximum and at elbows.
3. Below Grade:
   a. Install in accordance with Manufacturer's recommendations and ASTM D 2321.
   b. Stabilize unstable trench bottoms.
   c. Bed pipe true to line and grade with continuous support from firm base.
      1) Bedding depth: 4 to 6 inches 100 to 150 mm.
      2) Material and compaction to meet ASTM standard noted above.
   d. Excavate bell holes into bedding material so pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
   e. Trench width at top of pipe:
      1) Minimum: 18 inches 450 mm or diameter of pipe plus 12 inches 300 mm, whichever is greater.
      2) Maximum: Outside diameter of pipe plus 24 inches 600 mm.
   f. Do not use backhoe or power equipment to assemble pipe.
   g. Initial backfill shall be 12 inches 300 mm above top of pipe with material specified in referenced ASTM standard.
   h. Minimum cover over top of pipe not under building slab:
      1) 36 inches 900 mm before wheel loading.
      2) 48 inches 1 200 mm before compaction.

D. Install piping so cleanouts may be installed as follows:
1. Where shown on Drawings and near bottom of each stack and riser.
2. At every 135 degrees of accumulative change in direction for horizontal lines.
3. Every 100 feet 30 meters of horizontal run.
4. Extend piping to accessible surface. Do not install piping so cleanouts must be installed in carpeted floors. In such locations, configure piping so wall type cleanouts may be used.

E. Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have seal trap in connection with complete venting system so gasses pass freely to atmosphere with no pressure or syphon condition on water seal.

F. Vent entire waste system to atmosphere. Join lines together in fewest practicable number before projecting above roof. Set back vent lines so they will not pierce roof near edge or valley. Vent line terminations shall be:
1. 6 inches 150 mm minimum above roof and 12 inches 300 mm minimum from any vertical surface.
2. Same size as vent pipe.
3. In areas where minimum design temperature is below 0 deg F minus 18 deg C or where frost or snow closure may be possible:
   a. Vent line terminations shall be same size as vent pipe, except no smaller than 2 inches 50 mm in diameter.
   b. Vents shall terminate 10 inches 250 mm minimum above roof or higher if required by local codes.

G. Furnish and install firestopping at penetrations of fire-rated structures as required under Sections 07 8400 and 22 0501.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
1. Conduct tests for leaks and defective work. Notify Architect before testing.
2. Metal Pipe System: After backfilling and compacting of trenches is complete but before placing floor slab, fill waste and vent system to roof level with water, 10 feet 3 meters minimum, and show no leaks for two hours. Uncover pipe and correct leaks and defective work. Re-backfill and compact and re-test.
3. Thermoplastic Pipe System:

a. Before backfilling and compacting of trenches, cap all open ends and pressure test to 6 psi for 2 hours with no leaks. Correct leaks and defective work.
b. After backfilling and compacting of trenches is complete but before placing floor slab, re-test as specified above. Uncover pipe and correct leaks and defective work. Re-backfill and compact and re-test.

END OF SECTION

SECTION 33 4116

SITE STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. Perform excavating and backfilling required for work of this Section.
2. Furnish and install storm drainage system as described in Contract Documents from point of water collection to terminating point.

B. Related Requirements:
1. Section 31 2316: Procedure and quality of excavating.
2. Section 31 2323: Procedure and quality of backfilling and compacting.

1.2 REFERENCES

A. Reference Standards:
1. ASTM International:
   a. ASTM C 14-05a, 'Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.'
   b. ASTM C 76-05b, 'Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.'
   c. ASTM C 564-03a, 'Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.'
   d. ASTM D 2321-05, 'Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.'
   e. ASTM D 3034-04a, 'Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.'
   f. ASTM D 3212-96a (2003), 'Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.'
   g. ASTM F 794-03, 'Standard Specification for Poly(Vinyl Chloride)(PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.'
   h. ASTM F 1336-02, 'Standard Specification for Poly(Vinyl Chloride)(PVC) Gasketed Sewer Fittings.'

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:
1. Bedding Material: 3/8 inch 10 mm crushed gravel.
2. Catch Basins, Curb Inlets, Etc:
   a. Concrete:
      1) Construct of 4000 psi minimum concrete.
      2) Include cover inlet with cast iron frame and grate as shown on Drawings.
   b. PVC:
      1) Comply with requirements of ASTM D 3212. ASTM F 794, and ASTM F 1336.
      2) Metal grates, Frames, and hoods shall comply with ASTM A 536, Grade 70-50-05.
      3) Type One Acceptable Products:
         a) Nyloplast-ADS, Buford, GA (866) 888-8479. www.nyloplast-us.com.

b) Equal as approved by Architect before bidding. See Section 01 6200.

3. Concrete Pipe:
   a. Non-Reinforced: Meet requirements of ASTM C 14.
   b. Reinforced:
      1) Meet requirements of ASTM C 76, plain end.
      2) Determine class of pipe by depth of cover over pipe at rough-graded elevations as follows:

a)	Depth Of Cover	Class Of Pipe
b)	Under 2 feet 600 mm	V
c)	2 feet to 3 feet 600 to 900 mm	IV
d)	3 feet to 6 feet 900 to 1 800 mm	III
e)	Over 6 feet 1 800 mm	II

4. PVC Pipe And Fittings:
   a. Meet requirements of ASTM D 3034, SDR 35.
   b. Fittings: Slip Joint type with elastomeric seals.

PART 3 - EXECUTION

3.1 PREPARATION

A. Excavate and backfill as specified in Section 31 2316 and 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Drawings.
   2. Excavate to required depth.
   3. Grade to obtain fall required.
   4. Remove debris from trench before laying bedding and pipe.
   5. Do not cut trenches near footings without consulting Architect.
   6. Backfill only after pipe lines have been tested, inspected, and approved by Architect.

3.2 INSTALLATION

A. Concrete Pipe:
   1. Provide 3 inches 75 mm of uncompacted bedding material below pipe.
   2. After installation of pipe, provide additional bedding material up to springline of pipe.

B. PVC / Polyethylene Pipe:
   1. Install in accordance with ASTM D 2321.
   2. Minimum cover for corrugated polyethylene pipe and fittings shall be 12 inches 300 mm for H-20 load.

C. Use jacks to make-up gasketed joints.

3.3 FIELD QUALITY CONTROL

A. Failure to install joints properly shall be cause for rejection and replacement of piping system.

3.4 CLEANING

A. Remove excess earth from site or place as directed by Architect.

END OF SECTION