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SECTION 02050 - DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Utility lines, and other items to be demolished and/or abandoned are as shown.

1.2 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Schedule of demolition, as part of and consistent with the progress schedule specified in Section 01310, PROGRESS/CRITICAL PATH SCHEDULES.
 - 2. Copies of any authorizations and permits required to perform Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PREPARATION

- A. Utilities:
 - 1. Notify CONTRACTING OFFICER or appropriate utilities to turn off affected services before starting demolition or alterations.
 - 2. Remove utility lines exposed by demolition excavation.
 - 3. Remove electric, sanitary, water, and storm drainage adjacent to buildings to be demolished.
 - 4. Excavate utility lines serving buildings to be demolished and provide a permanent leak-proof closure for water and gas lines.

3.2 DEMOLITION

- A. Drawings define minimum required demolition. Unless otherwise shown, rough cuts or breaks may be made exceeding limits of demolition shown.
- B. Core drill floor slabs, catch basins, and other concrete improvements to remain in place below ground, or break holes at structure's lowest point to allow water to freely migrate through.

- C. Remove piping as shown and from any other areas that interfere with CONTRACTOR's work. Pipe, valves, and fittings adjacent to those to be removed may also be removed as salvage.
- D. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 6 inches below final finished surface.
- E. Perform site cleanup daily before leaving the work site. Store equipment in a neat and orderly arrangement.
- F. Abandonment of Buried Utility Piping Systems:
 - 1. Plug pipelines at exposed excavations and at manholes or other utility structures with minimum 5-foot long concrete plug.
 - 2. Manholes/wet wells/drainage structures:
 - a. Remove frames and covers/grates for salvage.
 - b. Remove structures shown on Drawings.
 - c. Backfill as described herein.
- G. Demolition of utility poles, street signs and similar items:
 - 1. Remove entire structure, including portions below ground.
 - 2. Remove and separate items for salvage.
 - 3. Backfill as described herein.

3.3 DISPOSAL

- A. Dispose of debris and other nonsalvaged materials off base at location selected by CONTRACTOR.

3.4 BACKFILLING

- A. Demolished Areas: Backfill to existing ground level or foundation level of new construction.
- B. Backfill Material and Compaction:

1. Conform to Section 02220, FILL AND BACKFILL.
2. Do not use demolition debris as backfill material.

3.5 SALVAGE

- A. Equipment and materials, including piping within the limits of demolition, unless otherwise specified, will become the property of the CONTRACTOR.

END OF SECTION

SECTION 02060 - SELECTIVE DEMOLITION FOR ASBESTOS ABATEMENT (Removal)

PART 1 - GENERAL

1.0 RELATED DOCUMENTS:

Drawing and general provisions of Contract, including General and Special Contract Conditions and other Specification sections, apply to Work of this Section.

1.1 DESCRIPTION OF WORK:

- A. Types of Selective Demolition Work Demolition may require the selective removal and subsequent off site disposal of the following, but not necessarily limited to:
1. Portions of building structure as required to access asbestos-containing materials (ACM).
 2. Removal of walls.
 3. Removal of ceilings.
 4. Removal of column covers.
 5. Removal and protection of existing fixtures and equipment items
- B. Selective Demolition does not include structural building demolition but applies only to demolition needed to access asbestos containing material (ACM). No structural or load-bearing walls shall be removed prior to completion of abatement.

1.2 SUBMITTALS:

Schedule: Submit schedule indicating proposed methods and sequence of operations for selective demolition Work to Project Manager for review and written approval prior to commencement of Work. Include coordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.

- A. Provide detailed sequence for demolition and removal Work.
- B. Permit for transport and receipts for disposal of debris.

1.3 JOB CONDITIONS:

- A. Abatement: Conduct selective demolition Work in a manner that will minimize disruption.
- B. Condition of Structures: The Owner assumes no responsibility for actual condition of items or structures to be demolished.

Conditions existing at time of commencement of Contract will be maintained by Owner insofar as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition Work.

- C. Protections: Provide temporary barricades and other forms of protection as required to protect the Owner's personnel from injury due to selective demolition Work.
1. Provide protective measures as required to provide free and safe passage of personnel. Provide, erect and maintain barricades, lighting and guardrails as required by applicable regulatory agencies to protect workers.
 2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished, and adjacent facilities or Work to remain.
 3. Protect from damage existing mechanical, electrical and conveyor systems that are to remain in place and become exposed during demolition operations.
 4. Provide temporary weather protection during interval between abatement and demolition of existing construction to insure that no water leakage or damage occurs to structure or interior areas of existing building.
 5. Provide for continuous operation of Contractor's life-safety and emergency systems, including, but not limited to, emergency lighting, fire alarm systems, smoke removal systems, and fire sprinkler and standpipe systems. Where interruption of such services is unavoidable, provide minimum of 72 hours advance notice to Owner and governing agencies having jurisdiction. Provide alternative arrangements during period of interruption that have been approved and accepted in writing by all applicable governing and regulatory agencies.
 6. Remove protections at completion of Work.
- D. Damages: Where demolition of existing architectural features and construction abuts or interfaces with existing construction to remain, repair the damaged area to match adjacent construction.
- E. Traffic: Conduct selective demolition operations and debris removal in a manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

Do not close, block or otherwise obstruct streets, walks or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by

governing regulations.

- F. Explosives: Use of or possession of explosives will not be permitted.
- G. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations. Arrange and pay for disconnecting, removing and capping utility services within area of demolition.

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

- H. Environmental Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.

PART 2 - PRODUCTS (As indicated or as required)

3.0 PREPARATION:

- A. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

Cease operations and notify the Project Manager immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

- B. Erect and maintain dust-proof partitions and closures if necessary to prevent spread of dust or fumes to other portions of the building.
- C. Provide weatherproof closures for exterior openings resulting from demolition Work.

3.1 DEMOLITION:

- A. Perform selective demolition Work in a systematic manner.
 - 1. It shall be the Contractor's responsibility to establish the extent of such Work and to see that all such Work is completed to access the asbestos-containing material (ACM).
 - 2. All items to be removed shall be stored on site and disposed of by the Contractor.

2. Demolish concrete and masonry in small sections using power-driven masonry saw or hand tools; do not use power-driven impact tools.
 4. Promptly remove debris to avoid imposing excessive loads on supporting walls, floors or framing.
 5. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction.
 6. Neatly and completely cut through material and remove demolished material as carefully as possible.
 7. Where existing floors or walls must be drilled or cut to perform selective demolition Work; patch and repair is not required.
- B. If unanticipated mechanical, electrical or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Project Manager in written, accurate detail. Pending receipt of directive from Project Manager rearrange selective demolition schedule as necessary to continue overall job progress without delay.

3.2 DISPOSAL OF DEMOLISHED MATERIALS:

Remove debris, rubbish and other materials resulting from demolition operations from building. Store in area designated by the Project Manager. The Contractor will transport and legally dispose of materials off site.

- A. If hazardous materials are encountered during demolition operations (e.g. lead containing materials, PCBs etc.), comply with applicable regulations, laws, and ordinances concerning removal, handling, disposal, and protection against exposure or environmental pollution.
- B. Comply with asbestos abatement procedures included in specifications where asbestos containing materials are encountered.
- C. Burning of removed materials is not permitted.

3.3 CLEAN-UP AND REPAIR:

- A. Upon completion of demolition Work, remove tools, equipment and partitions from site.
- B. Repair of structures or surfaces soiled or damaged by selective demolition Work is not required.
- C. Remove any non-ACM debris resulting from selective demolition and store in area

designated by the Project Manager. The Contractor will dispose of these materials.

END OF SECTION 02060

SECTION 02070 - SELECTIVE DEMOLITION

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes, but is not limited to, the following:

- Demolition and removal of selected site elements including site pavements and slabs-on-grade.
- Disconnecting, capping or sealing, and abandoning or removing existing site utilities.
- Demolition and removal of dumpster screen walls, slab-on-grade footings, and associated elements.
- Demolition and removal of fencing.
- Relocation of existing site utilities, including light poles.
- Demolition and removal of existing underground concrete rubble. Refer to Specification Section 02200.
- Demolition and removal of other above and below grade improvements to accommodate new construction.
- Demolition and removal of existing trench drain.
- Patching and repairing.
- Demolition and removal of curb and gutter.

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

- Division 1 Section "Cutting and Repairing" for cutting and repairing procedures for selective demolition operations.
- Division 2 Section "Site Clearing" for site clearing and removal of topsoil and vegetation.
- Division 2 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

Division 2 Section "Landscape Work" for relocation of trees.

DEFINITIONS

Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Government's property.

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

MATERIALS OWNERSHIP

Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Government's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option, unless otherwise indicated.

SUBMITTALS

Schedule indicating proposed sequence of operations for selective demolition work for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required.

Coordinate with adjacent facilities to permit continuing occupation of existing building and parking areas.

QUALITY ASSURANCE

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

JOB CONDITIONS

Occupancy: Conduct selective demolition work in manner that will minimize need for disruption of adjacent Government's normal operations. Provide minimum of 72 hours advance notice to Contracting Officer's Representative of demolition activities that will affect adjacent occupied facilities.

Condition of Structures: The Government assumes no responsibility for actual condition of items or structures to be demolished.

Conditions existing at time of inspection for bidding purposes will be maintained by Government insofar as practicable.

Partial Demolition and Removal: Items indicated to be removed but of salvageable value to Contractor may be removed as work progresses. Transport salvaged items from site as they are removed.

Storage or sale of removed items on site will not be permitted.

SELECTIVE DEMOLITION

Protections: Provide temporary barricades and other forms of protection to protect from injury due to selective demolition work.

Conduct operations to prevent damage to adjacent buildings, structures, sidewalks, pavements, and other facilities and to prevent injury or damage to persons or property.

Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.

Remove protections at completion of work.

Damages: Promptly repair damages caused to adjacent facilities by demolition work.

Environmental Controls: Comply with governing regulations pertaining to environmental protection.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

EXAMINATION

Verify that utilities have been disconnected and capped.

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

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

UTILITY SERVICES

Maintain existing utilities to remain in service and protect them against damage during selective demolition operations.

Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Contracting Officer and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Government.

Provide not less than 72 hours' notice to Contracting Officer if shutdown of service is required during changeover.

Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services.

Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other used or occupied buildings before proceeding with selective demolition.

PREPARATION

General: Provide interior and exterior shoring, bracing, or support to preserve stability and prevent movement, settlement, or collapse of areas to be demolished.

Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, acids, or other dangerous materials before proceeding with selective demolition operations.

Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Government. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective demolition area.

Erect temporary protection, such as walks and fences, as needed for protection.

Protect existing site improvements, appurtenances, and landscaping to remain.

DEMOLITION

General: Perform selective demolition work in a systematic manner. Use methods required to complete work within limitations of governing regulations and as follows:

Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping.

Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations.

Maintain portable fire-suppression devices during flame-cutting operations.

Maintain adequate ventilation when using cutting torches.

Remove decayed, vermin-infested, or unsuitable materials and promptly dispose of off-site.

Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.

Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain, using power-driven masonry saw or hand tools; do not use power-driven impact tools.

Break up and remove concrete slabs on grade, footings, and foundations, unless otherwise shown to remain.

Completely fill below-grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 inches in diameter, roots, or other organic matter and thoroughly compact to specified criteria per Section 02200.

DISPOSAL OF DEMOLISHED MATERIALS

Remove from building site debris, rubbish, and other materials resulting from demolition operations, unless otherwise acceptable to Contracting Officer. Transport and legally dispose off site.

If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.

Burning of removed materials is not permitted on project site.

PATCHING AND REPAIRING

Promptly patch and repair damaged surfaces caused to adjacent construction by selective demolition operations.

Patching is specified in Division 1 Section "Cutting and Repairing."

Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

END OF SECTION 02070

SELECTIVE DEMOLITION

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SECTION 02080 – BASIC MATERIALS AND METHODS – PIPED UTILITIES

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Sleeves.
 - 5. Identification devices.
 - 6. Grout.
 - 7. Piped utility demolition.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Concrete bases.
 - 10. Metal supports and anchorages.

1.2 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. 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.
- C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

PART 2 – PRODUCTS

2.1 JOINING MATERIALS

- A. Refer to individual Division 2 piping Sections for special joining materials not listed below.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. 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 (3.2-mm) 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 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- D. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- E. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- F. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- G. Brazing Filler Metals: AWS A5.8, BCuP Series, or BAg1, unless otherwise indicated.
- H. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

- I. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- J. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

2.2 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solderjoint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, fullface-or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035-or 2070-kPa) minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.3 SLEEVES

- A. Mechanical sleeve seals for pipe penetrations are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.4 IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
 - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
 - 2. Location: Accessible and visible.
- B. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.
- C. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressuresensitive vinyl type with permanent adhesive.
- D. Plastic Duct Markers: Manufacturer's standard laminated plastic, in the following color codes:
 - 1. Green: Cold-air supply.
 - 2. Yellow: Hot-air supply.
 - 3. Blue: Exhaust, outside, return, and mixed air.
 - 4. Hazardous Material Exhausts: Use colors and designs recommended by ASME A13.1.

5. Terminology: Include direction of airflow; duct service such as supply, return, and exhaust; duct origin; duct destination; and design flow.
- E. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils (0.08 mm) thick.
- 1 Width: 1-1/2 inches (40 mm) on pipes with OD, including insulation, less than 6 inches (150 mm); 2-1/2 inches (65 mm) for larger pipes.
 - 2 Color: Comply with ASME A13.1, unless otherwise indicated.
- F. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) sequenced numbers. Include 5/32-inch (4-mm) hole for fastener.
- 1 Material: 0.032-inch- (0.8-mm-) thick, polished brass or aluminum.
 - 2 Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.
- G. Engraved Plastic-Laminate Signs: 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 Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
 - 2 Thickness: 1/16 inch (1.6 mm), for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) in length, and 1/8 inch (3 mm) for larger units.
 - 3 Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.
- H. Plastic Equipment Markers: Manufacturer's standard laminated plastic. Use colors and designs recommended by ASME A13.1.
- 1 Terminology: Match schedules as closely as possible. Include the following:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions,

and speed.

- 2 Size: 2-1/2 by 4 inches (65 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.

2.5 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 (34.5-MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 – EXECUTION

3.1 PIPED UTILITY DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable,

remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 2 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- H. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. PVC Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum board partitions.
- K. Verify final equipment locations for roughing-in.

- L. 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 2 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. 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.
- E. 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. 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.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

3.6 IDENTIFICATION

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 - 1. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
 - 2. Locate pipe markers on exposed piping according to the following:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
 - c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
 - d. At manholes and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.
 - 1. Lettering Size: Minimum 1/4 inch (6.4 mm) high for name of unit if viewing distance is less than 24 inches (610 mm), 1/2 inch (13 mm) high for distances up to 72 inches (1800 mm), and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.

2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

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 (100 mm) larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Use 3000-psi (20.7-Mpa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.7.1 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 02080

SECTION 02081 -REMOVAL OF ASBESTOS CONTAINING MATERIALS

PART 1 - GENERAL

1.0 RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Special Contract Conditions and other Specification sections, apply to Work of this section.

1.1 RELATED WORK SPECIFIED ELSEWHERE:

- A. Establishment of Negative Pressure System set forth in Section 01513.
- B. Installation of Critical and Primary Barriers, and Work Area isolation procedures are set forth in Section 01526.
- C. Project Decontamination procedures after removal of the secondary barrier are specified in Section 01711.
- D. Disposal of asbestos containing waste is specified in Section 02084.
- E. For all materials listed or discovered during the Work removal, methods shall be in accordance with OSHA 1926.1101.

1.2 SUBMITTALS:

- A. Before Start of Work: Submit the following to the Project Manager for review. Do not start Work until these submittals are returned with Project Manager's acceptance.
 - 1. Surfactant: Submit product data, MSDS, use instructions and recommendations from manufacturer of surfactant intended for use. Include data substantiating that material complies with specification requirements. MSDS sheets must be immediately available for on-site review.
 - 2. Encapsulants: Submit product data, MSDS, use instructions and recommendations from manufacturer of encapsulants intended for use. Include data substantiating that material complies with specification requirements. MSDS sheets must be immediately available for on-site review.
 - 3. NESHAPS Certification: Submit certification from manufacturer of surfactant or removal encapsulant that, to the extent required by this specification, the material, if used in accordance with manufacturer's instructions, will wet asbestos containing materials to which it is applied as required by the National Emission Standard for Hazardous Pollutants

(NESHAPS) Asbestos Regulations (40 CFR 61, Subpart M).

1. Material Safety Data Sheet: Submit the Material Safety Data Sheet, or equivalent, in accordance with the OSHA Hazard Communication Standard (29 CFR 1910.1200) for each surfactant, encapsulating material, chemical solvents, paints, or any other product proposed for use on the Work. Include a separate attachment for each sheet indicating the specific worker protective equipment proposed for use with the material indicated.

PART 2 - PRODUCTS

- A. Wetting Materials: For wetting prior to disturbance of asbestos containing materials use either amended water or a removal encapsulant:
- B. Amended Water: Provide water to which a surfactant has been added. Use a mixture of surfactant and water which results in wetting of the asbestos containing material and retardation of fiber release during disturbance of the material equal to or greater than that provided by the use of one ounce of a surfactant consisting of 50% polyethylene ester and 50% polyethylene ether mixed with five gallons of water.
- C. Removal Encapsulant: Provide a penetrating type encapsulant designed specifically for removal of asbestos containing material. Use a material which results in wetting of the asbestos containing material and retardation of fiber release during disturbance of the material equal to or greater than that provided by water amended with a surfactant consisting of 50% polyethylene ester and 50% polyethylene ether mixed with five gallons of water.
- D. Lock Down Encapsulant: After completion of wet cleaning and prior to the removal of barriers and plastic lining, apply a single "tack coat" of penetrating encapsulant as a post-removal encapsulant. Encapsulant application shall follow manufacturer's recommendations and shall be compatible with any replacement materials.
- E. Polyethylene Sheet: Provide polyethylene film, largest size possible to minimize seams, 4.0 or 6.0 mils thick as required.
- F. Duct Tape: Provide duct tape in 2" or 3" widths as indicated, with an adhesive that is formulated to aggressively stick to sheet polyethylene.
- G. Spray Adhesive: Provide spray adhesive in aerosol cans, which are specifically formulated to stick tenaciously to sheet polyethylene. Spray cement will only be used to adhere sections of sheet polyethylene together.
- H. Disposal Bags: Provide 6 mil thick leak-tight polyethylene bags labeled with two labels with text as follows:

First Label:

CAUTION
Contains Asbestos Fibers
Avoid Opening or Breaking Container
Breathing Asbestos is Hazardous to Your Health

Second Label: Provide in accordance with 29 CFR 1910.1200(f) of OSHA's Hazard Communication standard:

DANGER
ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
BREATHING AIRBORNE ASBESTOS, TREMOLITE, ANTHOPHYLLITE, OR
ACTINOLITE FIBERS IS HAZARDOUS TO YOUR HEALTH

PART 3 - EXECUTION

3.0 REGULATED AREA:

Set up regulated area according to the following Sections:

1. 01513 Negative pressure System
2. 01526 Temporary Enclosures
3. 01563 Decontamination Units

3.1 WORKER PROTECTION:

Before beginning Work with any material for which a Material Safety Data Sheet has been submitted provide workers with the required protective equipment. Require that appropriate protective equipment be used at all times.

3.2 WET REMOVAL:

- A. Thoroughly wet to satisfaction of Project Manager asbestos containing materials to be removed prior to stripping to reduce fiber dispersal into the air. Accomplish wetting by a fine spray (mist) of amended water or removal encapsulant. Saturate material sufficiently to wet to the substrate without causing excess dripping. Allow time for water or removal encapsulant to penetrate material thoroughly. If amended water is used, spray material repeatedly during the Work process to maintain a continuously wet

condition. If a removal encapsulant is used, apply in strict accordance with manufacturer's written instructions. Perforate outer covering of any installation which has been painted and/or jacketed in order to allow penetration of amended water or removal encapsulant, or where necessary, carefully strip away while simultaneously spraying amended water or removal encapsulant on the installation to minimize dispersal of asbestos fibers into the air. High-pressure power washers are prohibited.

For bulk removal activities, they may be used for final cleaning following a visual examination of the area that determines the bulk materials are removed.

- B. Mist Work Area continuously with amended water whenever necessary to reduce airborne fiber levels.
- C. Remove saturated asbestos containing material in small sections from all areas. Do not allow material to dry out. As it is removed, if disposal bags are used, simultaneously pack material while still wet into disposal bags. Twist neck of bags, bend over and seal with minimum three wraps of duct tape. Clean outside and move to washdown station adjacent to material decontamination unit.

SCOPE OF WORK FOR ASBESTOS ABATEMENT IN ROOMS 101, 102 and 103 OF THE FUEL CELL/CORROSION CONTROL BUILDING

GENERAL CONDITIONS:

- i) No quantities of ACM are provided for this portion of the project. Contractor shall be responsible for determining quantities of ACM as a basis of its bid.
- ii) The plans indicate general locations of asbestos containing material that are known to exist in the areas shown on the drawings. Contractor shall include in its bid all costs necessary to discover and remove all ACM materials within each structure in conformance with Colorado Regulation No. 8. Contractor shall include in their bid, all costs associated with removal of any architectural finish surfaces to gain adequate access to all asbestos containing materials as determined by the Owner. Architectural finish surfaces may include, but are not limited to the following: lay-in ceilings and grids, plaster and lath ceilings and walls, sheet rock ceilings and walls, support frames, aluminum or steel fascia panels, ducts or conduit runs that interfere with access, etc. Contractor shall fully investigate the complexity and waste material volumes for gaining access to the asbestos containing materials. In the hidden areas where ACM has been identified, discovered or removed, the contractor shall remove enough of the finish surfaces to allow convenient access for visual inspections of the areas by the Owner. The purpose of the inspections shall be to visually verify that all ACM has been removed. The bid price shall include access as well as removal costs for all encountered ACM materials within the project boundaries. The plans indicate general areas where ACM is known to exist. There may be other areas within the project boundaries that

contain materials which are also asbestos containing. Contractor shall remove all ACM that is encountered or discovered during the execution of the project. ACM to be removed is that which is required to be removed prior to demolition as per Colorado Regulation # 8. Contractor shall fully investigate the project area to determine quantities and access requirements to remove all asbestos, whether indicated on drawings or not, and shall include in its bid all costs for asbestos removal.

- iii) Several areas may require removal of components to gain access to the asbestos materials (e.g., sections of ductwork, mechanical equipment, sheet rock walls, etc.).
- iv) The Contractor may encounter hidden or concealed areas that contain hidden asbestos insulated fittings, fire proofed beams, etc. The Contractor shall hold further demolition in such areas and shall immediately notify Project Manager for confirmation of ACM. If ACM is confirmed, the Contractor shall remove the ACM as part of its lump sum bid.

SCOPE OF WORK

A. Rooms 101, 102 and 103 of the Fuel Cell/Corrosion Control Building

- 1. Remove and dispose of the following materials as ACM in Rooms 101, 102 and 103
 - a. All identified asbestos containing vinyl asbestos floor tile and associated mastic
- 2. Special Conditions for Rooms 101, 102 and 103:
 - a. Parking for the Contractor is available adjacent to the Building 800, but outside the security fence.
 - b. Base access is controlled by the Contracting Officer and is through the base gates.
 - c. Building access will be through the controlled access port in Building 801 next door, or through the vehicle gate adjacent to Building 800 with Security Force coordination.
 - d. Setup access will be on the outside of the Building (north side) where two doors exist to Rooms 101 and 102. Room 103 is accessed through Room 102. The Contractor must use this access area for decontamination, loadout and material storage. Water and sanitary lines will need to be run through the Room 102 corridor to the sink in Room 105 (janitor's closet).

- e. Room 101 contains a ceiling-mounted unit heater. Room 102 has no HVAC service. Room 103 contains a window-mounted air conditioner.
- f. The foam tank and compressor in Room 101 will need to be protected in place.

3.3 AIRBORNE FIBER COUNTS:

General: Use Work procedures that result in an 8 hour Time Weighted Average (TWA) airborne fiber count less than that indicated in the section of these specifications on Project Oversight, Section 1410 (Air Monitoring/Laboratory Services). If airborne fiber counts exceed this level immediately mist the area with amended water to lower fiber counts and revise Work procedures to maintain airborne fiber levels within the required limit.

END OF SECTION 02081

SECTION 02084 - DISPOSAL OF ASBESTOS CONTAINING MATERIAL

PART 1 - GENERAL

1.0 RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Special Contract Conditions and other Specification sections, apply to Work of this section.

1.1 DISPOSAL

Friable and non-friable asbestos containing waste material and debris which is packaged in accordance with the provision of this Specification will be disposed of at the Denver Arapahoe Disposal Site.

1.2 SUBMITTALS:

Submit copies of all manifests and landfill receipts to Project Manager on a weekly basis.

PART 2 - PRODUCTS (Not Used) PART 3 - EXECUTION

3.0 GENERAL:

- A. Carefully load containerized waste on sealed trucks or other appropriate vehicles for transport. Exercise care before and during transport, to ensure that no unauthorized persons have access to the material.
- B. Do not store bagged ACM outside of the Work Area. Take bags from the Work Area directly to a sealed truck or dumpster. Use a lined "Hopper" type for transport of double-bagged material to outside truck or dumpster.
- C. Do not transport bagged ACM on open trucks. Double-bagged material may be transported on open trucks if they are first loaded in sealed drums. Label drums with same warning labels as bags. Uncontaminated drums may be reused. Treat drums that have been contaminated as asbestos containing waste and dispose of in accordance with this specification.
- D. Advise the Denver Arapahoe Disposal Site, at least twenty-four hours in advance of transport, of the quantity of material to be delivered.
- E. At the Denver Arapahoe Disposal Site, sealed plastic bags must be carefully removed from the truck. If bags are broken or damaged, leave in the truck and clean entire truck and contents using procedures set forth in section 01711 Project Decontamination.
- F. Retain receipts from landfill for disposal of materials. All manifests for disposal at

DADS will be generated by the Owner. The Owner will directly pay disposal costs at DADS when the Denver Generated Manifest is used. Contractor shall bear disposal costs at DADS, at no additional cost to the Owner if non-Denver Generated Manifests are utilized. Contractors shall transmit the shipper's copy of the manifest to the Owner on a weekly basis.

- G. Friable, OSHA Category II non-friable asbestos and OSHA Category I non-friable asbestos shall be disposed of at the Denver Arapahoe Disposal Site. The Denver Arapahoe Disposal Site shall handle all non-friable asbestos waste so that it does not become friable

END OF SECTION 02084

SECTION 02086 - SPECIAL CONDITIONS - ASBESTOS ABATEMENT (Removal)

PART 1 - GENERAL

1.0 RELATED DOCUMENTS:

Drawings and general provisions of contract, including General and Special Contract Conditions and other Specification sections, apply to Work of this section.

1.1 SPECIAL PROJECT CONDITIONS:

- A. **Work Hours:** The Owner will pay for 40 hours per week of oversight. All hours over this will be at the expense of the Contractor, unless an addendum is issued by the Project Manager stating otherwise.
- B. **Isolation of Work Area:** Contractor shall use barrier tape to isolate Work Area from the rest of the Buildings while temporary enclosures and barriers are being constructed.
- C. **Water Leak:** In case of water leak the Contractor shall at a minimum follow the procedures outlined below:
 - 1. Cease abatement operations in the area of the leak;
 - 2. Rope off and isolate area immediately;
 - 3. Mop up water and place water in appropriate container;
 - 4. Place plastic 6 mil polyethylene drop cloth under leak;
 - 5. Place 5-gallon plastic bucket under leak to catch water;
 - 6. Take necessary action to stop and fix water leak;
 - 7. Filter water from leak through shower unit filter as the water is considered to contain asbestos;
 - 8. Dispose of mop heads and drop cloths as asbestos containing materials;
 - 9. Clean (HEPA vac and wet wipe) other materials which came in contact with the leaking water or dispose of as asbestos containing materials;
 - 10. Mop area with clean water.
- D. **Other Emergencies:** Notify Project Manager immediately.
- E. **Off-Hours Emergencies:** Contractor is required to respond within two hours to any off-hours emergency. Contractor shall provide Project Manager with key personnel contact phone numbers prior to starting work.
- F. **Where the Work Area is open to the building exterior,** Contractor shall construct a barrier to the weather consisting of a minimum of 2"x 4" wood studs and 6 mil poly sheeting that is designed to withstand expected weather elements and remain weather tight.

- G. There shall be no smoking anywhere on the project site. Contractor shall vigorously enforce the smoking provisions for all employees, site visitors and sub-contractors.

1.2 SPECIAL PROJECT EQUIPMENT:

- A. Electrical Power: Contractor shall coordinate with Owner's electrician to access electrical power, which can be drawn from the main panel board in Building 1000.
- B. Storage Trailer: Contractor shall be required to have a lockable storage trailer or dumpster for storage of bagged asbestos containing waste located in the Contractor's off-site staging area.
- C. Office/Break-room Trailer: Contractor shall be required to have an office/lunchroom/break-room trailer for use by all workers, supervisors, and foreman, and visits by all other personnel. Trailer must be equipped with means of communication with workers, as well as all emergency agencies. Communication means must also be available for use by Project Manager. Contractor shall supply own potable water. Contractor's personnel may use the restrooms located in Rooms 104 and 107.
- D. Two-Way Communications: Contractor shall provide two-way communications between general superintendent, abatement superintendent, Project Manager and other required parties for the duration of the project. System shall have a minimum range capable of encompassing all work areas.
- E. Contractor shall provide all necessary equipment to tie into water sources located in Room 105 (janitor's closet). The piping shall be insulated to protect from freezing, if necessary.
- F. Contractor shall provide all necessary equipment to tie into sanitary lines located in Room 105 (janitor's closet).
- G. Contractor shall provide all necessary lighting to complete the project.

END OF SECTION 02086

SECTION 02088 - DEMOLITION (NON-FRIABLE ACM LEFT IN BUILDING)

PART 1 - GENERAL

1.0 RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Special Contract Conditions and other Specification sections, apply to this Section.

1.1 DESCRIPTION OF WORK:

- A. All non-friable ACM shall remain non-friable during the demolition of the building, in accordance with Colorado Department of Public Health and Environment Regulation No. 8.
- B. All non-friable ACM shall be disposed of at the Denver Arapahoe Disposal Site in accordance with all applicable regulations.
- C. Contractor shall comply with OSHA regulations in regard to worker protection.
- D. Non-friable ACM left in place for demolition includes but not limited to:
 - 1. Roofing Materials
 - 2. Roof Flashing
 - 3. White and Tan Window Caulking Interior & Exterior
 - 4. Other items listed in Scope of Work for Specific Structures
 - 5. Sheet-rock tape and mud
 - 6. Window glazing and caulk
 - 7. Slab caulk
- E. Non-friable ACM may not be subjected to:
 - 1. Burning
 - 2. Explosion
 - 3. Grinding
 - 4. Recycling/Crushing
 - 5. Selective demolition Activities

PART 2 – PRODUCTION

(Not Applicable)

PART 3 – EXECUTION

3.0 GENERAL

- A. Contractors shall notify all employees, sub-contractors and visitors that non-friable ACM materials are being left in the structure for demolition and disposal in conformance with Colorado Regulation No. 8.
- B. Contractors shall conduct negative exposure assessment monitoring during demolition to verify that workers are not being exposed to asbestos fibers.
- C. Contractors may dispose of the listed non-friable materials with the general demolition debris in conformance with Colorado Regulation No. 8 and the requirements of the Denver Arapahoe Disposal Site facility. For this to be applicable, the non-friable asbestos must be part of the general demolition debris, and not have been separated at any point.
- D. Debris that contains non-friable asbestos may not be sent off site for recycling or sold for reuse. It must be disposed of at the Denver Arapahoe Disposal Site. This includes wood with asbestos roofing, concrete with asbestos tile or mastic, etc.
- E. Listed, non-friable materials may not be cut, sheared, broken, etc., to access other components without asbestos removal engineering controls in place. This includes hand cutting asbestos sheet-rock to expose underlying elements as an example. Demolition and removal as part of the larger destruction process is acceptable as long as negative exposure assessments have been conducted and personnel will not be further working in the non-friable debris.

END OF SECTION 02088

SECTION 02100 - SITE PREPARATION
PART 1 GENERAL

1.1 DEFINITIONS

- A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.
- B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.
- C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2 inches caliper to a depth of 6 inches below subgrade.
- D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.
- E. Stripping: Removal of topsoil remaining after applicable scalping is completed.
- F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.2 QUALITY ASSURANCE

- A. Obtain CONTRACTING OFFICER's approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

1.3 SCHEDULING AND SEQUENCING

- A. Prepare site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls to maximum of 5 acres.

PART 2 PRODUCTS (NOT USED) PART 3

EXECUTION

3.1 GENERAL

- A. Clear, grub, and strip areas actually needed for waste disposal, borrow, or site improvements within limits shown or specified.
- B. Do not injure or deface vegetation that is not designated for removal.

3.2 LIMITS

- A. As follows, but not to extend beyond Project limits.
 - 1. Excavation 5 feet beyond top of cut slopes.

2. Fill:
 - a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
 - b. Stripping 2 feet beyond toe of permanent fill.
 3. Structures: 15 feet outside of new structures.
 4. Along trenchlines minimum 5 feet wider than trench width at ground surface.
 5. Other Areas: As shown.
- B. Remove rubbish, trash, and debris from entire area within Project limits. Dispose of off base.

3.3 CLEARING

- A. Clear areas within limits shown or specified.
- B. Fell trees so that they fall away from facilities and vegetation not designated for removal.
- C. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

3.4 GRUBBING

- A. Grub areas within limits shown or specified.

3.5 SCALPING

- A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.
- B. Scalp areas within limits shown or specified.

3.6 STRIPPING

- A. Do not remove topsoil until after scalping is completed.
- B. Strip areas within limits to full depth of topsoil. Do not remove subsoil with topsoil.
- C. Stockpile strippings, meeting requirements of Section 02920, SOIL PREPARATION, for topsoil, separately from other excavated material.
- D. Excess topsoil shall be delivered to an on-base location as directed by the CONTRACTING OFFICER.

- E. All material which is unsuitable for use as topsoil or backfill, and material not required for backfill, shall be disposed of off-base by the CONTRACTOR.

3.7 SALVAGE

- A. Saleable timber may be sold to CONTRACTOR's benefit. Promptly remove from Base.

3.8 DISPOSAL

- A. Clearing and Grubbing Debris:

1. Dispose of debris off base.
2. Woody debris may be chipped. Chips may be sold to CONTRACTOR's benefit or used for landscaping onsite as mulch or uniformly mixed with topsoil, provided that resulting mix will be fertile and not support combustion. Maximum dimensions of chipped material used onsite shall be 1/4-inch by 2 inches. Dispose of chips that are unsaleable or unsuitable for landscaping or other uses with unchipped debris off base.
3. Limit off base disposal of clearing and grubbing debris to locations off base that are approved by federal, state, and local authorities.

- B. Scalpings: As specified for clearing and grubbing debris.

- C. Strippings:

1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil off base.
2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

END OF SECTION

SECTION 02110 - SITE CLEARING

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

Removal of vegetation. Refer to Specification Section 02900 for relocation of existing trees.

Topsoil stripping.

Clearing and grubbing.

Removing existing above-grade and below-grade site improvements within construction limits. Refer to Specification Section 02070.

PROJECT CONDITIONS

Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from Government and authorities having jurisdiction.

Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements to remain in place.

Protect improvements on adjoining properties and on Government's property.

Restore damaged improvements to their original condition, as acceptable to property owners.

EXISTING SERVICES

General: Indicated locations are approximate; determine exact locations and elevations of all utilities before commencing Work.

Place markers to indicate location of underground services. Identify locations on Project Record Documents.

PART 2 - PRODUCTS

Not applicable to this Section.

PART 3 - EXECUTION

SITE CLEARING

General: Remove shrubs, grass and other vegetation, improvements, or obstructions as required to permit installation of new construction. Removal includes digging out and off-site disposing of stumps, roots, and other underground obstructions.

Refer to Specification Section 02070 for removal of existing site pavements and underground concrete rubble.

Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.

Strip topsoil in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass before stripping.

Stockpile topsoil in storage piles in areas as directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion.

Stripped topsoil, if approved by Landscape Architect, shall be used exclusively for finish grading.

Dispose of unsuitable topsoil same as specified for disposal of waste material.

Provide new topsoil as required to comply with Specification Section 02900.

Clearing and Grubbing: Clear site of trees, shrubs and other vegetation, except for those indicated to remain.

Completely remove stumps, roots, and other debris protruding through ground surface.

Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact to specified criteria per Section 02200.

Removal of Improvements: Remove existing improvements as necessary to facilitate new construction.

DISPOSAL OF WASTE MATERIALS

Burning on Government's Property: Burning is not permitted on Government's property, unless Burning Permit is obtained.

Removal from Government's Property: Remove waste materials and unsuitable topsoil from Government's property and dispose of in lawful manner.

END OF SECTION 02110

SECTION 02140 - DEWATERING

PART 1 GENERAL

1.1 SUBMITTALS

A. Administrative Submittals:

1. Well permits.
2. Discharge permits.

1.2 WATER CONTROL PLAN

A. As a minimum, include:

1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply, pollution control facilities, discharge locations to be utilized, and provisions for immediate temporary water supply as required by this section.
2. Drawings showing locations, dimensions, and relationships of elements of each system.
3. Design calculations demonstrating adequacy of proposed dewatering systems and components.

B. If system is modified during installation or operation revise or amend and resubmit Water Control Plan.

PART 2 PRODUCTS (NOT USED) PART 3

EXECUTION

3.1 GENERAL

- A. Remove and control water during periods when necessary to properly accomplish Work.

3.2 SURFACE WATER CONTROL

- A. See Section 01500, CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS, Article TEMPORARY CONTROLS.

- B. Remove surface runoff controls when no longer needed.

3.3 DEWATERING SYSTEMS

- A. Provide, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry and to lower and maintain groundwater level a minimum of 2 feet below the lowest point of excavation. Continuously maintain excavations free of water, regardless of source, and until backfilled to final grade.
- B. Design and Operate Dewatering Systems:
 - 1. To prevent loss of ground as water is removed.
 - 2. To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.
 - 3. To relieve artesian pressures and resultant uplift of excavation bottom.
- C. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.
- D. Provide 100 percent emergency power backup with automatic startup and switchover in event of electrical power failure.

3.4 DISPOSAL OF WATER

- A. Obtain discharge permit for water disposal from authorities having jurisdiction.
- B. Treat water collected by dewatering operations, as required by regulatory agencies, prior to discharge.
- C. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.

3.5 PROTECTION OF PROPERTY

- A. Make assessment of potential for dewatering induced settlement. Provide and operate devices or systems, including but not limited to reinjection wells, infiltration trenches and cutoff walls, necessary to prevent damage to existing facilities, completed Work, and adjacent property.
- B. Securely support existing facilities, completed Work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

END OF SECTION 02140

SECTION 02160 - EXCAVATION SUPPORT SYSTEMS

PART 1 GENERAL (NOT USED) PART 2

PRODUCTS (NOT USED) PART 3 EXECUTION

3.1 GENERAL

- A. Design, provide, and maintain shoring, sheeting, and bracing as necessary to support the sides of excavations and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

3.2 REMOVAL OF EXCAVATION SUPPORT

- A. Remove excavation support in manner that will maintain support as excavation is backfilled and not leave voids in backfill.
- B. Do not begin to remove excavation support until support can be removed without damage to existing facilities, completed Work, or adjacent property.

3.3 TRENCHES

- A. For trench excavation exceeding 5 feet in depth, provide adequate safety system meeting requirements of applicable state and local construction safety orders, and federal requirements.

END OF SECTION

SECTION 02200 - EARTHWORK

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

Preparing and grading subgrades for building slabs, walks, and pavements.

Preparing stabilized low volume change zone for support of building slabs and pavements.

Excavating and backfilling for underground mechanical and electrical utilities and buried site, mechanical, and electrical appurtenances.

Importing and placing required soil fill materials.

Backfilling of void created by removal of underground concrete rubble. Refer to Section 02070.

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

Division 2 Section "Selective Demolition" for removal of underground concrete rubble.

Division 2 Section "Site Clearing" for site stripping including removal of trees and vegetation.

Division 2 Section "Excavation, Trenching and Backfilling for Utilities", for trenching and backfilling.

Division 2 Section "Landscape Work" for finish grading, including importing, placing and preparing topsoil for lawns and planting.

DEFINITIONS

Excavation consists of removal of material encountered to subgrade elevations indicated, including removal of unacceptable existing fill materials beneath foundation bearing levels and slabs-on-grade. All footings shall bear on acceptable underlying native soils and all unsuitable material shall be removed and disposed of.

Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Contracting Officer. Unauthorized excavation, as well as

remedial work directed by Contracting Officer, shall be at Contractor's expense.

Under footings, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Contracting Officer and Soil Testing Lab.

In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Contracting Officer.

Subgrade: The undisturbed earth or the compacted soil layer immediately below slabs, pavements, or topsoil materials.

Structure: Buildings, foundations, slabs, curbs, or other man-made stationary features occurring above or below ground surface.

Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.

SUBMITTALS

Test Reports: Submit the following reports directly to Contracting Officer's Representative and Architect from the testing services, with copy to Contractor:

Test reports on fill and borrow material, including laboratory analysis.

Verification of suitability of each footing subgrade material, in accordance with specified requirements.

Field reports; in-place soil density tests.

One optimum moisture-maximum density curve for each type of soil material.

Report of actual unconfined compressive strength and/or results of bearing tests.

QUALITY ASSURANCE

Codes and Standards: Perform earthwork and excavation work in compliance with applicable requirements of authorities having jurisdiction.

Testing and Inspection Service: Contractor shall employ and pay for a qualified independent geotechnical testing laboratory to classify proposed on-site fill and borrow soils to verify that soils comply with specified requirements and to perform soil testing and inspection service during earthwork operations.

Pre-installation Conference: Conduct conference at Project site

Before commencing earthwork, meet with the Contracting Officer's Representative, Architect,

Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

PROJECT CONDITIONS

Site Information: Data in subsurface investigation report was used for the basis of the design and is available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that neither Government nor Architect will be responsible for interpretations or conclusions drawn from this data by Contractor.

Additional test borings and other exploratory operations may be performed by the Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

Existing Utilities: Locate existing utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.

Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Government and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

Do not interrupt existing utilities serving occupied facilities, except when permitted in writing by Contracting Officer and then only after acceptable temporary utility services have been provided.

Provide minimum of 48-hour notice to Contracting Officer and receive written notice to proceed before interrupting any utility.

Use of Explosives: Use of explosives is not permitted.

Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights and other appropriate barriers.

Operate warning lights as recommended by authorities having jurisdiction.

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

PART 2 - PRODUCTS

SOIL MATERIALS

EARTHWORK

General: Obtain approved borrow soil materials from adjacent stockpiles when sufficient approved soil materials are not available from excavations.

Satisfactory soil materials for fill and backfill:

Clean excavated materials or approved borrow material free from organic material and debris.

Silty or sandy clay with a maximum liquid limit of 35% and plasticity index less than 15 but no less than 5.

Silty or clayey sand with a minimum 15% fines by dry weight passing #200 sieve.

ACCESSORIES

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

PART 3 - EXECUTION

PREPARATION

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

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

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

EXCAVATION

Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

STABILITY OF EXCAVATIONS

General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.

Contractor shall obtain Digging Permit prior to commencing excavation.

All excavations shall be constructed and shored in accordance with OSHA requirements.

Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having

jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

DEWATERING

Dewatering methods shall be in accordance with the “Guidebook of Best Management Practices for Michigan Watersheds.”

Prevent surface water and subsurface or groundwater from flowing into excavations, from ponding on prepared subgrades, and from flooding project site and surrounding area.

Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rainwater and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

STORAGE OF EXCAVATED MATERIALS

Stockpile excavated materials acceptable for backfill and fill where directed. Place, grade, and shape stockpiles for proper drainage. Cover, if required, to prevent wind-blown dust.

Locate and retain soil materials away from edge of excavations.

EXCAVATION FOR STRUCTURES

Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection.

Excavations for footings and foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

EXCAVATION FOR PAVEMENTS AND WALKS

Cut surface under pavements and walks to comply with elevations and grades as indicated.

COLD WEATHER PROTECTION

Protect excavation bottoms against freezing when atmospheric temperature is less than 35° F.

BACKFILL AND FILL

General: Place soil material in layers to required subgrade elevations, for each area classification listed below, using materials specified in this Section.

Under grassed areas, use satisfactory excavated or fill material. Provide topsoil, minimum depth 6", for finish grading as specified in Section 02900.

Under building slabs, use satisfactory fill material and stabilized low volume change zone. Clean sand is unacceptable as a fill material.

Under pavements and walks, use satisfactory fill material and stabilized low volume change zone. Under piping and conduit, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation. Shape excavation bottom to fit bottom 90° of cylinder.

Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.

Concrete is specified in Division 3.

Do not backfill trenches until tests and inspections have been made and backfilling is authorized by Contracting Officer. Use care in backfilling to avoid damage or displacement of pipe systems.

Provide 4-inch-thick concrete base slab support for piping or conduit 8 inches and smaller and less than 2'-6" below surface of roadways and pavements. After installation and testing of piping or conduit, provide minimum 4-inch-thick encasement (sides and top) of concrete prior to backfilling or placement of pavement subbase.

Utility trenches entering the structure from the exterior shall be plugged a minimum of 4 feet on each side of the exterior building foundation wall with compacted natural clay fill or low cement sand mix (2 sack) concrete as approved by Soil Testing Lab.

Backfill excavations as promptly as work permits, but not until completion of the following:

Acceptance of construction below finish grade including, where applicable, waterproofing and perimeter insulations.

Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.

Removal of concrete formwork.

Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.

Removal of trash and debris from excavation.

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

PLACEMENT AND COMPACTION

Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills.

Strip topsoil from construction areas as specified in Section 02110. Topsoil shall be used exclusively for finish grading.

Following topsoil removal, strip existing on-site fill material and miscellaneous debris from under building slabs on grade and pavements. A minimum of 18 inches of existing fill shall be removed and replaced with newly compacted fill under the building floor slab. Exact extent of existing fill material to be removed shall be determined by Soil Testing Lab.

Site preparation procedures shall be applied a minimum of one foot laterally beyond all edges of footing foundations or pavements for each foot of vertical fill required, or a minimum of five feet beyond the edge of building slabs on grade or pavements, whichever is greater.

Following completion of stripping and grading operations, and prior to any scarification, exposed subgrades shall be proofrolled with several passes, in mutually perpendicular directions, using rubber-tired heavy construction equipment weighing a minimum of 25 tons. Suitable proofrolling equipment would include such items as a fully loaded dump truck or scraper. Proofrolling operations shall be observed by qualified geotechnical personnel. Any area which cannot be satisfactorily densified in-place shall be removed and replaced with approved, properly compacted fill material.

All unsuitable materials, including materials that become soft and yielding during proofrolling operations, shall be removed and replaced with acceptable and properly compacted fill material.

Following completion of proofrolling activities and correction of all problem areas, exposed subgrades shall be scarified to a minimum depth of 6 inches, then adjusted in moisture content and compacted as herein specified.

All fill materials shall be free from organic matter and debris and shall consist of approved materials acceptable to Soil Testing Lab. Fill materials shall have a liquid limit of less than 35%, a maximum Plasticity Index of 15, a minimum Plasticity Index of 5, and contain a minimum of 15% fines (material passing the #200 sieve).

All compacted fill shall be placed under controlled conditions and placed under observation of Soil Testing Lab representative.

Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

Before compaction, moisten or aerate each layer as necessary to provide specified moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

COMPACTION AND MOISTURE CONTROL

General: Control soil compaction during construction providing minimum and maximum percentages of density specified for each area classification and moisture contents as indicated.

Compaction: Maximum dry density shall be as determined by ASTM Designation D-1557. Compaction for filling and backfill operations shall be as follows:

1. Fill under Footings: Minimum of 95% of maximum dry density.
2. Fill under Floor Slabs: Minimum of 92% of maximum dry density.
3. Fill under Pavements: Minimum of 95% of maximum dry density.
4. Non-Structural Fill and Backfill: Minimum of 85% of maximum dry density.

Moisture Content: Moisture content shall be controlled during construction based on an acceptable range of moisture content as determined by Modified Proctor, ASTM D-1557. Moisture content shall be as follows:

1. Fat Clay, Lean Clay: Minimum of 2% above optimum moisture content.
(CH, CL, MH)
2. Silts, Clayey Sand, Sandy Clay: 2% to + 2% of optimum moisture content.
(GM, GC, SM, SC, ML)
3. Sands, Gravel: At workable moisture content.
(GM, GP, SW, SP)

Footings Foundations: Footings shall bear on underlying native soils.

All footing excavations shall be inspected by Soil Testing Lab to ensure that all existing fill is removed.

All bearing materials shall be evaluated by qualified geotechnical personnel at the time of foundation construction. Evaluation shall be accomplished by performing one test probe at each isolated foundation location and additional probes as determined by the testing agency along continuous footings.

Test probes shall extend a minimum of 3 feet below foundation bearing level or into underlying native soils. In-situ testing and testing of recovered samples from probes shall be performed as necessary to adequately evaluate bearing materials encountered.

Unsuitable existing fill and objectionable materials shall be removed and foundations shall be lowered to bear on approved, suitable material. Any over excavation required because of unsuitable soils shall extend laterally in all directions beyond the edges of the foundation, a minimum of 8 inches for each 12 inches of over excavated depth.

Care shall be taken to minimize wetting or drying of the exposed soil during foundation construction. All loosened or disturbed material, or extremely wet or dry material, shall be removed from the foundation excavation prior to placing reinforcing steel and concrete.

Building Floor Slabs: Scarified subgrade and fill material below floor slabs, shall be adjusted in moisture content and compacted as specified.

All newly placed fill material beneath floor slabs shall consist of approved material, free from organic matter and debris. All fill shall be placed as soon as possible following scarifying procedures in order to minimize drying or excessive wetting of exposed subgrade soils.

Fill material used beneath floor slabs shall be as herein specified and shall be examined and approved by Soil Testing Lab prior to use. A stabilized low volume change zone shall be constructed beneath floor slabs as specified.

Pavements: Exposed subgrades shall be scarified and adjusted in moisture content and compacted as specified.

A stabilized low volume change zone shall be constructed beneath pavements as specified.

Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.

Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density. Where soils become too dry, take appropriate measures to develop the minimum moisture level.

Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

Correct improperly compacted areas or lifts as directed by Contracting Officer if soil density tests indicate inadequate compaction.

BUILDING SLAB AND PAVEMENT STABILIZED SUBGRADE

General: Stabilized subgrade consists of placing stabilized materials, in layers to specified thickness, and compacting to specified density with proper moisture content, over subgrade surface supporting building slabs and pavements.

Stabilized Subgrade: A low volume change zone shall be constructed below floor slabs and pavements. Low volume change zone shall be a minimum of 12" thick, exclusive of any granular level course under floor slabs and a minimum of 9" thick under pavements.

Low volume change zone under floor slabs may be constructed of either imported low volume change fill materials acceptable to Soil Testing Lab or stabilized on-site cohesive soils.

Imported fill material used to develop low volume change zone shall consist of soils as specified and as acceptable to Soil Testing Lab. Limestone screenings may be used as approved by Soil Testing Lab.

Low volume change zone under pavements shall be constructed of stabilized in-place soils.

On-site soils shall be stabilized with hydrated lime. A minimum of 4% lime shall be used, based on the dry unit weight of the soil.

Stabilizing agent shall be completely and uniformly blended into site soils using mechanical mixers. Application procedures shall be performed in accordance with MDOT requirements.

Low volume change zone materials, including percentage of stabilization material, shall be approved by Soil Testing Lab. Provide written documentation of acceptability of low volume change materials from Soil Testing Lab.

The lift thickness, moisture content, and compaction of stabilized low volume change zone material shall be as specified for building floor slabs and pavements.

The stabilized low volume change zone under pavements and aprons shall extend a minimum distance of 1 foot beyond the edge of driveways, pavements, and aprons.

GRADING

General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.

Finish surfaces free from irregular surface changes and as follows:

Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.

Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation.

Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than ½ inch above or below required subgrade elevation.

Positive Drainage: Topsoil and fill material shall be sloped at a minimum grade of 5% for a minimum distance of 10 feet to provide positive drainage away from building foundations, slabs-on-grade, pavements and sidewalks.

Grading Surface of Fill under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of ½ inch when tested with a 10-foot straightedge.

Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum density for each area classification.

TOPSOIL

Topsoil shall be stockpiled for re-use in finish grading if acceptable to Contracting Officer. If quality or quantity of stockpiled topsoil is inadequate or insufficient, provide additional topsoil as required to provide a 6" minimum thickness over area within disturbed construction limits.

Provide new topsoil that is fertile, friable, natural loam, surface soil, free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth.

Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

FIELD QUALITY CONTROL

Quality Control Testing During Construction: Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.

Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2167 (rubber balloon method), as applicable.

Field density tests may also be performed by the nuclear method in accordance with ASTM

D 2922, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gages in accordance with ASTM D 3017.

If field tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Contracting Officer.

Footing Subgrade: For each strata of soil on which footings will be placed, perform at least one test to verify required design bearing capacities and perform test probes as specified. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata when acceptable to Contracting Officer and Soil Testing Lab.

Paved Areas and Building Slab Subgrade: Perform at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab, but in no case fewer than three tests.

In each compacted fill layer, perform one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case fewer than three tests.

Foundation Wall Backfill: Perform at least two field density tests at locations and elevations as directed.

If subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained.

EROSION CONTROL

Provide erosion control methods in accordance with requirements of authorities having jurisdiction and as shown on the drawings.

MAINTENANCE

Maintenance Program: A regular maintenance program shall be implemented during the construction period to identify areas where water is standing adjacent to building foundations. These areas shall be repaired immediately to provide positive drainage away from the building.

Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace

surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

DISPOSAL OF EXCESS AND WASTE MATERIALS

Removal from Government's Property: Remove waste materials, including unacceptable excavated material, trash and debris, and legally dispose of it off Government's property.

END OF SECTION 02200

SECTION 02205 - EXCAVATION
PART 1 GENERAL

1.1 SUBMITTALS

A. Shop Drawings:

1. Excavation Plan, Detailing:

- a. Methods and sequencing of excavation.
- b. Proposed locations of stockpiled excavated material.
- c. Proposed spoil disposal sites.
- d. Anticipated difficulties and proposed resolutions.

1.2 QUALITY ASSURANCE

- A. Provide adequate survey control to avoid unauthorized overexcavation.

1.3 WEATHER LIMITATIONS

- A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.
- B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.4 SEQUENCING AND SCHEDULING

- A. Demolition: Complete applicable Work specified in Section 02050, DEMOLITION, prior to excavating.
- B. Clearing, Grubbing, and Stripping: Complete applicable Work specified in Section 02100, SITE PREPARATION, prior to excavating.
- C. Dewatering: Conform to applicable requirements of Section 02140, DEWATERING, prior to initiating excavation.

PART 2 PRODUCTS (NOT USED) PART 3

EXECUTION

3.1 GENERAL

- A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 0.1-foot except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.
- B. Overexcavation Beneath Finished Grade:
 - 1. Column Footings: 2 feet below final grade, maximum.
 - 2. Slab-on-Grade: 1 foot below final grade, maximum.
- C. Backfill overexcavation as specified in Section 02220, FILL AND BACKFILL.
- D. Remove or protect obstructions as shown and as specified in Section 01500, CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS, Article PROTECTION OF WORK AND PROPERTY.

3.2 UNCLASSIFIED EXCAVATION

- A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

3.3 TRENCH WIDTH

- A. Minimum Width of Trenches:
 - 1. Single Pipes, Conduits, Direct-Buried Cables, and Duct Banks:
 - a. Less than 4-inch Outside Diameter or Width: 18 inches.
 - b. Greater than 4-inch Outside Diameter or Width: 18 inches greater than outside diameter or width of pipe, conduit, direct-buried cable, or duct bank.
 - 2. Multiple Pipes, Conduits, Cables, or Duct Banks in Single Trench: 18 inches greater than aggregate width of pipes, conduits, cables, duct banks, plus space between.
 - 3. Increase trench widths by thicknesses of sheeting.
- B. Maximum Trench Width: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to existing facilities, adjacent property, or completed Work.

3.4 EMBANKMENT AND CUT SLOPES

- A. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.
- B. Remove stones and rock that exceed 3-inch diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.
- C. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities, adjacent property, or completed Work.

3.5 STOCKPILING EXCAVATED MATERIAL

- A. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.
- B. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.
- C. Confine stockpiles to within easements, rights-of-way, and approved work areas. Do not obstruct roads or streets.
- D. Do not stockpile excavated material adjacent to trenches and other excavations unless excavation sideslopes and excavation support systems are designed, constructed, and maintained for stockpile loads.
- E. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

3.6 DISPOSAL OF SPOIL

- A. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, off base.
- B. Dispose of debris resulting from removal of underground facilities as specified in Section 02050, DEMOLITION, for demolition debris.
- C. Dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in Section 02100, SITE PREPARATION, for clearing and grubbing debris.

END OF SECTION

SECTION 02210 - IRWIN ROAD UNDERCROSSING

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This section covers the work necessary for construction of the bore and jacking of 16-inch casing pipe under Irwin Road.

1.2 GENERAL

- A. Prevent surface disturbance or damage to Irwin Road.
- B. Trenchless methods acceptable for the pipe undercrossing include boring and jacking.

1.3 SUBMITTALS

- A. Submit Undercrossing Plan detailing the construction. Include specific information as described below:
 - 1. Schedule showing the sequence of operations for undercrossing activities.
 - 2. Layout Plan showing pits, staging areas, and special actions and procedures required for the method selected.
 - 3. Procedures for preventing surface damage or movement including grouting around casing pipe if appropriate.
 - 4. Procedure for protecting adjacent utilities from damage.
 - 5. Procedures for installing carrier pipe within casing pipe including installation of supports.
 - 6. Procedures for grouting voids outside of casing pipe.
 - 7. Methods for disposal of drilling mud, if used.
- B. Shop Drawings of all products specified herein or required for the construction.
- C. Record drawing plan and profile showing as constructed position of pipeline.

1.4 QUALITY ASSURANCE

- A. Provide key personnel with at least 5 years' experience for the proposed construction

and associated pipe installation, including pipe at least as large as required for this Work. Key personnel include field supervisor and operators of equipment, including position monitoring and steering equipment.

PART 2 PRODUCTS

2.1 CASING PIPE

- A. Type: Smooth steel pipe fabricated in sections with beveled ends in accordance with AWWA C200-91.
- B. Minimum Wall Thickness:

Casing Smooth Steel Pipe Diameter (Inches) Minimum Thickness

up to 24 1/4" 30-36 5/16"

2.2 GROUT

- A. Pressure Grouting Outside Carrier or Casing Pipe: 1 part portland cement and 3 parts sand (by volume).

2.3 STAINLESS STEEL CASING SPACERS

- A. Bolt-on style with a shell made in two sections of heavy T-304 stainless steel; connecting flanges ribbed for extra strength. Sized to bolt securely to carrier pipe.
- B. Shell lined with PVC liner with 85-90 Durometer.
- C. Nuts and bolts to be 18-8 stainless steel.
- D. Runners to be made of ultra high molecular weight polymer with high abrasion resistance and low coefficient of friction; supported by risers made of T-304 stainless steel.
- E. Supports to be mig welded to the shell; all welds fully passivated.
- F. Height of the supports and runners combined to keep the carrier pipe centered in the casing pipe at all locations.
- G. Minimum 8-inch length per spacer.
- H. Cascade Waterworks Mfg. Co., or approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Welding: Continuous butt weld at joints for rigid and watertight encasements.
- B. Casings for Crossings:
 - 1. Size, large enough to provide adequate working space allowing installation of carrier pipe to lines and grades shown.
 - 2. Provide minimum cover over all casing pipes.
- C. Grouting:
 - 1. Low pressure grouting equipment, having capacity to deliver grout under maximum pressure of 5 psi.
 - 2. Plug grout nipples until the grouting operation begins.
- D. Survey ground surface along centerline and along 20-foot offset on both sides of undercrossing at 5-foot intervals before and after construction of undercrossing.

3.2 PREPARATIONS

- A. Locate positions of entry and exit pits, establish elevation and horizontal datum for bore head control, and lay out pipe assembly area as required.
- B. Lay out and assemble pipe in a manner that does not obstruct adjacent roads.

3.3 CONSTRUCTION

- A. Comply with Section 02160, EXCAVATION SUPPORT SYSTEMS, and Section 02205, EXCAVATION.
- B. Dewater in accordance with Section 02140, DEWATERING.
- C. Bore and jacking operation to proceed upstream unless clearances to nearby facilities preclude this and approval for alternative installation is provided by CONTRACTING OFFICER.
- D. Install stainless steel casing spacers to sanitary sewer carrier pipe in accordance with spacer manufacturer's recommendations and spacing requirements, maximum 6 feet on center. Install carrier pipe and spacers in casing in accordance with spacer manufacturer's recommendations
- E. Construct end seals as shown on Plans.

3.4 ALIGNMENT REQUIREMENTS

- A. Alignment of sanitary sewer carrier pipe shall meet Charter Township of Harrison requirements as shown on the Plans.

3.5 HANDLING AND DISPOSAL OF DRILLING MUD AND CUTTINGS

- A. Make adequate provisions for handling and containing muddy water, drilling mud, and cuttings during drilling operations. Do not discharge these contaminants into waterways or surface areas adjacent to the construction activities.
- B. Construct mud pits at entry and exit points in manner that completely contains mud and prevents its escape.
- C. When onsite provisions for storing muddy water, drilling mud, or cuttings onsite are exceeded, haul contaminants away to suitable legal disposal site.

3.6 TESTING

- A. After pulling pipe sanitary sewer into position, but before attachment of adjacent sections of pipe, test pipe according to Charter Township of Harrison requirements as shown on the Plans.

3.7 GROUTING

- A. After casing is in position, fill all voids between excavation and casing completely with grout. For methods requiring drilling mud, completely displace drilling mud between pipe and walls of borehole.

3.8 DISTURBANCE OF SURFACE FEATURES

- A. Disturbance of surface features including surface settlement and pavement cracking or movement shall be considered a result of defective construction methods. The CONTRACTOR shall repair surface features to the satisfaction of the CONTRACTING OFFICER at CONTRACTOR's own cost.

END OF SECTION 02210

SECTION 02215 - SUBGRADE PREPARATION

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Society for Testing and Materials (ASTM):
 - a. D1557, Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-pound (4.54 kg) Rammer and 18-inch (457 mm) Drop.

1.2 DEFINITIONS

- A. Optimum Moisture Content: As defined in Section 02220, FILL AND BACKFILL.
- B. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.
- C. Relative Compaction: As defined in Section 02220, FILL AND BACKFILL.
- D. Relative Density: As defined in Section 02220, FILL AND BACKFILL.
- E. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil prior to placement of fill, roadway structure or base for floor slab.

1.3 SEQUENCING AND SCHEDULING

- A. Complete applicable Work specified in Sections 02050, DEMOLITION; 02100, SITE PREPARATION; and 02205, EXCAVATION, prior to subgrade preparation.

1.4 QUALITY ASSURANCE

- A. Notify CONTRACTING OFFICER when subgrade is ready for compaction or whenever compaction is resumed after a period of extended inactivity.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Prepare subgrade when unfrozen and free of ice and snow.

PART 2 PRODUCTS (NOT USED) PART 3

EXECUTION

3.1 GENERAL

- A. Keep subgrade free of water, debris, and foreign matter during compaction.
- B. Bring subgrade to proper grade and cross-section and uniformly compact surface.
- C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.
- D. Maintain prepared ground surface in finished condition until next course is placed.

3.2 COMPACTION

- A. Under Earthfill: Compact the upper 6 inches to minimum of 90 percent relative compaction as determined in accordance with ASTM D1557.
- B. Under Pavement or Structures: Compact the upper 6 inches to minimum of 95 percent relative compaction as determined in accordance with ASTM D1557.

3.3 MOISTURE CONDITIONING

- A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.
- B. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten drying process.

3.4 CORRECTION

- A. Soft or Loose Subgrade:
 - 1. Adjust moisture content and recompact, or
 - 2. Over excavate as specified in Section 02205, EXCAVATION, and backfill as specified in Section 02220, FILL AND BACKFILL.
- B. Unsuitable Material: Over excavate as specified in Section 02205, EXCAVATION, and backfill as specified in Section 02220, FILL AND BACKFILL.

END OF SECTION 02215

SECTION 02220 - FILL AND BACKFILL

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Society for Testing and Materials (ASTM):
 - a. C117, Standard Test Method for Materials Finer Than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing.
 - b. C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - c. D75, Standard Practice for Sampling Aggregates.
 - d. D1557, Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-pound (4.54 kg) Rammer and 18-inch (457 mm) Drop.
 - e. D2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods.
 - f. D4253, Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
 - g. D4254, Standard Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.

1.2 DEFINITIONS

- A. Relative Compaction:
1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D1557.
 2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by CONTRACTING OFFICER.
- B. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.
- B. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.
- C. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.
- D Completed Course: A course or layer that is ready for next layer or next phase of Work.
- E. Lift: Loose (uncompacted) layer of material.
- F. Geosynthetics: Geotextiles, geogrids, or geomembranes.
- G. Well-Graded:
1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.
 2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
 3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.
- I. Influence Area: Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:
1. 1-foot outside outermost edge at base of foundations or slabs.
 2. 1-foot outside outermost edge at surface of roadways or shoulder.
 3. 0.5-foot outside exterior at spring line of pipes or culverts.
- J. Borrow Material: Material from required excavations.
- K. Selected Backfill Material: Materials available onsite that CONTRACTING OFFICER determines to be suitable for specific use.
- L. Imported Material: Materials obtained from sources off base, suitable for specified use.

- M. Structural Fill: Fill materials as required under structures, pavements, and other facilities.
- N. Embankment Material: Fill materials required to raise existing grade in areas other than under structures.

1.3 SUBMITTALS

- A. Samples: Geotextile.
 - B. Quality Control Submittals:
 - 1. Catalog and manufacturer's data sheets for compaction equipment.
 - 2. Certified test results from independent testing agency.

1.4 QUALITY ASSURANCE

- A. Notify CONTRACTING OFFICER when:
 - 1. Structure or tank is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
 - 2. Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed.
 - 3. Fill material appears to be deviating from Specifications.

1.5 SEQUENCING AND SCHEDULING

- A. Complete applicable Work specified in Sections 02050, DEMOLITION; 02100, SITE PREPARATION; 02205, EXCAVATION; and 02215, SUBGRADE PREPARATION, prior to placing fill or backfill.
- B. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03301, REINFORCED CONCRETE. Obtain CONTRACTING OFFICER's acceptance of concrete work and attained strength prior to placing backfill.
- C. Do not place granular base, subbase, or surfacing until after subgrade has been prepared as specified in Section 02215, SUBGRADE PREPARATION.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

- A. Gradation Tests:

1. As necessary to locate acceptable sources of imported material.
2. During production of imported material, test as follows:
 - a. Granular Fill: 1 per 2,000 cubic yards, minimum 3.
 - b. Sand: 1 per 2,000 cubic yards, minimum 3.
 - c. Base Course: 1 per 2,000 cubic yards, minimum 3.
 - d. Foundation Stabilization Rock: 1 per 2,000 cubic yards, minimum 3.

2.2 EARTHFILL

- A. Excavated material from required excavations free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.
- B. Provide imported material of equivalent quality, if required to accomplish Work.

2.3 GRANULAR FILL

- A. 1-inch minus crushed gravel or crushed rock.
- B. Free from dirt, clay balls, and organic material.
- C. Well-Graded from coarse to fine and containing sufficient fines to bind material when compacted, but with maximum 8 percent by weight passing No. 2 sieve.

2.4 SAND

- A. Free from clay, organic matter, or other deleterious material.
- B. Gradation as determined in accordance with ASTM C117 and C136:

Sieve Size Percent Passing by Weight

1/4 inch 100

No. 4 95—100

No. 200 0—8

2.5 WATER FOR MOISTURE CONDITIONING

- A. Free of hazardous or toxic contaminants, or contaminants deleterious to proper compaction.

2.6 BASE COURSE

- A. As specified in Section 02236, BASE COURSES.

2.7 FOUNDATION STABILIZATION ROCK

- A. Crushed rock or pit run rock.
- B. Uniformly graded from coarse to fine.
- C. Free from excessive dirt and other organic material.
- D. Maximum 2-1/2 inches particle size.

2.8 GEOTEXTILE

- A. As specified on the Plans.

PART 3 EXECUTION

3.1 GENERAL

- A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.
- B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.
- C. During filling and backfilling, keep level of fill and backfill around each structure and buried tank even.
- D. Do not place fill or backfill, if fill or backfill material is frozen, or if surface upon which fill or backfill is to be placed is frozen.
- E. If pipe, conduit, duct bank, or cable is to be laid within fill or backfill:
 - 1. Fill or backfill to an elevation 2 feet above top of item to be laid.
 - 2. Excavate trench for installation of item.
 - 3. Install bedding, if applicable, as specified in Section 02225, TRENCH BACKFILL.
 - 3. Install item.
 - 4. Backfill envelope zone and remaining trench, as specified in Section 02225,

TRENCH BACKFILL, before resuming filling or backfilling specified in this section.

F. Tolerances:

1. Final Lines and Grades: Within a tolerance of 0.1-foot unless dimensions or grades are shown or specified otherwise.
2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

G. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

3.2 BACKFILL UNDER AND AROUND STRUCTURES

- A. Under Facilities: Within influence area beneath structures, slabs, pavements, curbs, piping, conduits, duct banks, and other facilities, backfill with granular fill, unless otherwise shown. Place granular fill in lifts of 6-inch maximum thickness and compact each lift to minimum of 95 percent relative compaction as determined in accordance with ASTM D1557.
- B. Other Areas: Backfill with granular fill to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of 6-inch maximum thickness and compact each lift to minimum of 90 percent relative compaction as determined in accordance with ASTM D1557.

3.3 FILL

- A. Outside Influence Areas Beneath Structures, Tanks, Pavements, Curbs, Slabs, Piping, and Other Facilities: Unless otherwise shown, place earthfill as follows:
 1. Allow for 6-inch thickness of topsoil where required.
 2. Maximum 8-inch thick lifts.
 3. Place and compact fill across full width of embankment.
 4. Compact to minimum 90 percent relative compaction as determined in accordance with ASTM D1557,
 5. Dress completed embankment with allowance for topsoil, crest surfacing, and slope protection, where applicable.

3.4 SITE TESTING

- A. Gradation:

1. One sample from each 1,500 tons of finished product or more often as determined by CONTRACTING OFFICER, if variation in gradation is occurring, or if material appears to depart from Specifications.
 2. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.
 3. Remove material placed in Work that does not meet Specification requirements.
- B. In-Place Density Tests: In accordance with ASTM D2922. During placement of materials, test as follows:
1. Granular Fill: 1 per acre, minimum 1 per lift.
 2. Sand: 1 per acre, minimum 1 per lift.
 3. Backfill Around Buried Tanks: Minimum 1 per lift.
 4. Base Course: As specified in Section 02236, BASE COURSE.

3.5 REPLACING OVEREXCAVATED MATERIAL

- A. Replace excavation carried below grade lines shown or established by CONTRACTING OFFICER as follows:
1. Beneath Footings: Granular fill.
 2. Beneath Slabs-On-Grade: Granular fill.
 3. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
 4. Trenches:
 - a. Unauthorized Overexcavation: Either trench stabilization material or granular pipe base material, as specified in Section 02225, TRENCH BACKFILL.
 - b. Authorized Overexcavation: Trench stabilization material, as specified in Section 02225, TRENCH BACKFILL.
 4. Permanent Cut Slopes (Where Overlying Area is Not to Receive Fill or Backfill):
 - a. Flat to Moderate Steep Slopes (3:1, Horizontal Run:Vertical Rise or Flatter): Earthfill.

- c. Steep Slopes (Steeper than 3:1):
 - 1) Correct overexcavation by transitioning between overcut areas and designed slope adjoining areas, provided such cutting does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities, adjacent property, or completed Work.
 - 2) Backfilling overexcavated areas is prohibited unless, in CONTRACTING OFFICER's opinion, backfill will remain stable, and overexcavated material is replaced as compacted earth fill.
- B. Place backfill for overexcavated areas in 6-inch loose lifts. Compact each lift to minimum of 95 percent relative compaction as determined in accordance with ASTM D1557.

3.6 GEOSYNTHETICS

- A. Install in accordance with manufacturer's recommendations.

3.7 PLACING FILL OVER GEOSYNTHETICS

A. General:

1. Place fill over geosynthetics with sufficient care so as not to damage them.
2. Place fill by back dumping and spreading only.
3. Dump fill only on previously placed fill.
4. While operating equipment, avoid sharp turns, sudden starts or stops that could damage geosynthetics.

- B. Hauling: Operate hauling equipment on minimum of 3 feet of fill.

C. Spreading:

1. Spreading equipment shall be track mounted, low ground pressure, D-6 or lighter.
2. Operate spreading equipment on minimum of 12 inches of fill over geosynthetics.
3. Spread fill in same direction as unseamed overlaps to avoid separation of seams and joints.

4. Never push fill downslope. Spread fill over sideslopes by pushing up from slope bottom. If access to bottom of slope is unavailable, progressively place fill, beginning at toe of slope and working upslope, with backhoe or dragline operated from top of slope. Limit distance material falls onto the geosynthetics to maximum of 2 feet.
 5. Correct wrinkles in geotextiles in accordance with manufacturer's recommendations.
 6. Maintain proper overlap of unseamed geosynthetics.
 7. Avoid overstressing geosynthetics and seams.
- D. Compaction: Compact fill only after uniformly spread to full thickness shown.
- E. Geosynthetic Damage:
1. Mark punctures, tears, or other damage to geosynthetics, so repairs may be made.
 2. Clear overlying fill as necessary to repair damage.
 3. Repairs to geosynthetics shall be made by respective installers as specified in respective specification section for each geosynthetic.

END OF SECTION 02220

SECTION 02236 - BASE COURSE

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. T 238, Standard Method of Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.2 DEFINITIONS

- A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight even surface, true to grade, line, and cross-section.
- B. Completed Lift: Compacted with uniform surface reasonably true to cross-section.
- C. Standard Specifications: 1996 Standard Specifications for Construction, Michigan Department of Transportation.

1.3 SUBMITTALS

- A. Samples: Submit for specified materials 15 days prior to delivery to site.
- B. Quality Control Submittals:
 - 1. Certified Test Results on Source Materials: Submit copies from commercial testing laboratory 15 days prior to delivery of materials to project.
 - 2. Certified Results of In-Place Density Tests from independent testing agency.

PART 2 PRODUCTS

2.1 BASE COURSE

- A. Class 21AA dense graded aggregate as specified in Section 902.06 of the Standard Specifications.

2.2 SOURCE QUALITY CONTROL

- A. CONTRACTOR: Perform tests necessary to locate acceptable source of materials meeting specified requirements.

- B. Final approval of aggregate material will be based on test results on installed materials.
- C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

- A. As specified in Section 02220, FILL AND BACKFILL.
- B. Obtain CONTRACTING OFFICER's acceptance of subgrade before placement of aggregate base course.
- C. Do not place base materials in snow or on soft, muddy, or frozen subgrade.

3.2 EQUIPMENT

- A. Compaction Equipment: Adequate in design and number to provide compaction and obtain the specified density for each layer.

3.3 HAULING AND SPREADING

- A. Hauling and Spreading: In accordance with Section 302.03 of the Standard Specifications.
- B. Hauling Materials:
 - 1. Do not haul over surfacing in process of construction.
- C. Spreading Materials:
 - 1. Distribute material to provide required density, depth, grade and dimensions with allowance for subsequent lifts.
 - 2. Produce even distribution of material upon roadway without segregation.
 - 3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.

3.4 CONSTRUCTION OF COURSES

- A. Construction of Courses: In accordance with Section 302.03 of the Standard Specifications.
- B. General: Complete each lift in advance of laying succeeding lift to provide

required results and adequate inspection.

3.5 ROLLING AND COMPACTION

- A. Rolling and Compaction: In accordance with Section 302.03 of the Standard Specifications.

3.6 FIELD QUALITY CONTROL

- A. In-Place Density Tests:
 - 1. Construct base course so areas shall be ready for testing.
 - 2. Perform a minimum of 1 test per acre, minimum 1 per lift in accordance with AASHTO T 191, T 205, or T 238 at locations acceptable to CONTRACTING OFFICER.

3.7 CLEANING

- A. Remove excess material; clean stockpile areas of aggregate.

END OF SECTION 02236

SECTION 02276 - MODULAR RETAINING WALL SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Conditions of the contract and Division 1 apply this Section.
- B. Provide all labor, materials and equipment to complete modular retaining walls as indicated in the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 - Earthwork/Site Preparation

1.3 QUALITY ASSURANCE

- A. Reference Standards
 - 1. ASTM C90-75 (1981 rev) - Hollow Load Bearing Masonry Units
 - 2. ASTM C140-75 (1981 rev) - Sampling and Testing Concrete Masonry Units
 - 3. ASTM C145-75 (1981 rev) - Solid Load Bearing Concrete Masonry Units

1.4 SUBMITTALS

- A. Refer to Section 01300 for Submittal Requirements.
- B. Product Literature: Submit manufacturer's product literature of concrete units and instruction methods.
- C. Samples: Submit samples when so requested by the Contracting Officer.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Contractor shall check the materials upon delivery to assure that proper material has been received.
- B. Contractor shall prevent excessive mud, wet cement, epoxy, and like materials which may affix themselves, from coming in contact with the materials.
- C. Contractor shall protect the materials from damage. Damaged material shall not be incorporated into the reinforced soil embankments.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Units

1. Concrete wall units shall have a minimum 28 day compressive strength of 2500 psi in accordance with ASTM C-90. The concrete shall have adequate freeze/thaw protection with a maximum moisture absorption rate of 6 percent.
2. Face dimensions may vary, because of splitting. Units are required to have a minimum of one third square foot of face area each.
3. Retaining wall units shall provide a minimum of 100 pounds per square foot of wall face area.
4. Exterior face shall be textured. Units shall have angled sides and be capable of attaining concave and convex curves.
5. Units shall be interlocked with non-corrosive nylon/fiberglass pins.
6. The units shall be interlocked as to provide a minimum of 3/4 inch of setback per each foot of wall height.

B. Acceptable Materials

1. Versa-Lok Retaining Wall units, or approved equal.

C. Base Material

1. Material for footing shall consist of compacted sands, gravel and/or concrete as shown on the construction drawings. A minimum of 4 inches of compacted base is required.

D. Unit Fill

1. A minimum of 12 inches of drainage fill must extend behind the wall to within 1 foot of final grade. Cap backfill with impervious material.
2. A minimum of 12 inches of drainage fill must extend behind the wall.

E. Backfill

1. Material shall be native material unless otherwise specified in the drawings. Unsuitable soils for backfill shall not be used within the reinforced soil mass when

using geogrid for tiebacks.

2. Where additional fill is required, contractor shall submit sample and specifications to the Contracting Officer to determine acceptability.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavation

1. Contractor shall excavate to the lines and grades shown on the construction drawings. Over-excavation shall not be paid for and replacement with compacted fill and/or wall system components will be required at contractor's expense. Contractor shall be careful not to disturb embankment materials beyond lines shown.

B. Foundation Soil Preparation

1. Foundation soil shall be excavated as required for footing dimensions shown on the construction drawings, or as directed by the Contracting Officer.
2. Foundation soils not meeting required strength shall be removed and replaced with acceptable material.
3. Over-excavated areas shall be filled with compacted backfill material.

C. Base Footing

1. Footing shall be placed as shown on the contract documents with a minimum thickness of 4 inches.
2. Footing materials shall be installed upon undisturbed native soils.
3. Material shall be compacted so as to provide a level hard surface on which to place the first course of units. Compaction will be with mechanical plate compactors to 95 percent of standard.
4. Footing shall be prepared to insure complete contact of retaining wall unit with base. Gaps shall not be allowed.

D. Unit Installation

1. First course of concrete wall units shall be placed on the footing. The units

shall be checked for level and alignment. The first course is the most important to insure accurate and acceptable results.

2. Units are placed side by side for full length of wall alignment. Alignment may be done by means of a string line or offset from base line.
3. Compact fill.
4. Sweep all excess material from top of units and install next course. Insure all voids between units are filled.
5. Lay up each course insuring that pins protrude into preceding courses a minimum of one inch. Two pins are required per unit. Pull unit forward as much as possible and backfill as the course is completed. Repeat procedure to the extent of wall height.

3.2 ADJUST AND CLEAN

- A. Clean premises of all litter, dirt and debris created by work of this Section.

END OF SECTION 02276

SECTION 02356 - DYNAMIC PILE TESTING
PART 1 GENERAL

1.1 DEFINITIONS

- A. High Strain Dynamic Testing (HSDT): Testing performed by the CONTRACTOR using Case-Goble Pile Driving Analyzer (PDA) to determine the drivability, pile toe and shaft friction capacity of specified piles, pile integrity and hammer performance. Gauges are attached to pile approximately 3 feet below pile head and connected with cable to monitoring station on ground away from pile. Gauges consist of two accelerometers, two strain transducers, and junction box.
- B. Impact Stress: Peak stress at pile head on impact from driving train as determined from measurements using pile driving analyzer.
- C. Transferred Hammer Energy: Energy transferred to the pile head from driving train impact, as determined from measurement using a Pile Driving Analyzer (PDA).
- D. Production Piles: Piles incorporated into the Work, utilizing a uniform selection of materials and workmanship, and which are determined acceptable by CONTRACTING OFFICER based on observation and pile test results.
- E. Test Piles: Piles constructed of same materials and workmanship, and installed as specified for production piles at production pile locations.

1.2 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Qualifications: PDA operator qualification.
 - 2. Test equipment description and layout.
 - 3. Test procedures.
 - 4. Test record documents.
 - a. Provide CONTRACTING OFFICER access to all real time data.
 - b. Provide CONTRACTING OFFICER within 24 hours of Data Collection Summary of all CAPWAP results.
 - c. Within 5 days of completing the Dynamic Pile Testing, submit final report of all tests results to the CONTRACTING OFFICER.

1.3 QUALIFICATIONS

- A. PDA Operator: At least 5 years' experience in Pile Testing.

1.4 PRE-DYNAMIC TESTING MEETING

- A. Discussion to include details and scheduling of testing.
- B. Attended by CONTRACTOR, testing agency, pile installation personnel, and CONTRACTING OFFICER before starting Work specified under this section.

1.5 STORAGE AND HANDLING

- A. As specified for production piles.

PART 2 PRODUCTS

2.1 TEST PILE ORDER LENGTHS

- A. Provide test piles in length sufficient for driving a minimum of 10 feet past the required pile toe elevations as specified in Section 02365, STEEL PILES and as indicated on the Drawings.

PART 3 EXECUTION

3.1 TEST PROCEDURES

- A. Perform Dynamic Testing in accordance with ASTM D4945.
- B. Test Pile shall be monitored with the PDA from the start of Initial Driving to the End of Initial Driving.
- C. Perform CAPWAP analysis for each pile tested on data that is representative at the end of initial driving and during the required restriking of selected test piles. One CAPWAP analysis will be required on each pile tested for End of Initial Driving and one additional test will be required for restrike conditions.

3.2 TEST PILE LOCATIONS

- A. Test Piles will be at locations selected by the CONTRACTING OFFICER. The CONTRACTING OFFICER will select up to 5 locations within the structural footprint. The CONTRACTING OFFICER will confer with the CONTRACTOR regarding Test Pile locations. The CONTRACTING OFFICER will have final authority in selecting the locations.

3.3 RECORD DATA

- A. Record for each test pile driven and tested, the following minimum information:
 - 1. High Strain Dynamic Testing Report: In accordance with referenced standard for tests performed.
 - 2. Driving record.
 - 3. Pile length.
 - 4. Number of hammer blows-per-each-foot of penetration.
 - 5. Resistance in blows-per-inch of last 12 inches of final driving.
 - 6. Hammer stroke, and rate of operation during driving (average for each foot of driving).
 - 7. Unusual occurrence(s) during driving.

3.4 TEST RECORD DOCUMENTS

- A. Make available to CONTRACTING OFFICER at site all real time dynamic monitoring data.
- B. Provide a report documenting all testing that includes, as a minimum, the following:
 - 1. FMAX representative of each foot.
 - 2. VMAX representative of each foot.
 - 3. EMAX representative of each foot.
 - 4. CASE METHOD ESTIMATES representative of each foot.
 - 5. Result of all CAPWAP analyses.

3.5 HIGH STRAIN DYNAMIC TESTING

- A. Testing Equipment: Furnish Pile Driving Analyzer (PDA), cables, gauges, and operator complete to performed the required testing.
- B. Provide the CONTRACTING OFFICER the following for inspection purposes:
 - 1. Access to pile head.
 - 2. Access to PDA Monitoring Station:
 - a. Driving operations and readout from PDA must be clearly visible to

monitoring personnel.

- C. Pile Driving Equipment: Use same hammer, driving system, and ancillary equipment to drive test piles and production piling. Maintain and operate driving equipment in accordance with manufacturer's instructions.
- D. Test Pile Preparation: Mark entire length of each test pile at 1-foot intervals and number marks consecutively starting at pile toe for the purpose of recording penetration resistance and depth of pile penetration. Make marks and numbering clearly visible for monitoring personnel. Upon request, perform additional marks at 1-inch intervals for selected feet.

E. Testing:

1. Perform in accordance with ASTM D4945:
2. Prepare test pile for dynamic monitoring and attach gauges in accordance with PDA operator's instructions.
3. Attach gauges while test pile is on ground to check for proper fit.
4. After checking gauge attachments with CONTRACTING OFFICER, remove gauges and cables from test pile segment, lift and spot pile, and place in leads.
5. Furnish and install gauges using necessary cables, bolts, and tools. Make platform available to CONTRACTING OFFICER for observation of gauge installation.
6. Take dynamic measurements during all test pile driving, and during all
of test piles.
7. After gauges are attached and accepted by CONTRACTING OFFICER,
proceed with test pile driving.
8. Halt driving when level of gauges approach the ground or if requested by the CONTRACTING OFFICER. If additional driving is required, complete pile splice and repeat gauge attachment process at top of next segment prior to continuation of driving.

restricking

F. Test Pile Installation:

1. Meet applicable requirements specified in Section 02365, STEEL PILES, for production piles.
2. Terminate impact driving upon CONTRACTING OFFICER's request.
3. CONTRACTING OFFICER will establish preliminary termination penetration resistance for each test pile based on pile ultimate capacity requirements, using wave

equation analysis, the Pile Hammer Data Sheet Submittal, test pile information as testing proceeds.

4. Provide a stable and suitable means or device to indicate penetration of the test piles, visible to CONTRACTING OFFICER and at a safe distance from pile driver.

G. Restriking Test Piles:

1. Conduct dynamic monitoring on all test piles to be restruck.
2. Minimum time between restriking and end of initial driving shall be 1 day for piling reaches pile toe elevation of 540 feet and achieves the Preliminary Termination Penetration Resistance provided by the CONTRACTING OFFICER. Minimum time between restriking and end of initial driving shall be 4 days if Preliminary Termination Penetration Resistance is not achieved before toe of pile reaches elevation of 530 feet.
3. Mount driving train on pile prior to attaching PDA gauges.
4. It is anticipated that restriking will include a total of 20 hammer blows for each test pile.
5. Up to 5 test piles may be restruck.

3.6 DAMAGED, MISPLACED, OR OTHERWISE REJECTED PILES

- A. Test piles found damaged, necked, or otherwise unfit for use that are located at production pile locations shall be replaced.
- B. Remove from site and replace with conforming piles.

3.7 USE OF TEST RESULTS BY CONTRACTING OFFICER

- A. The CONTRACTING OFFICER will provide Termination Penetration Resistance criteria for use in production pile installation within 24 hours of receiving results of CAPWAP analysis from CONTRACTOR.

END OF SECTION

SECTION 02365 - STEEL PILES

PART 1 GENERAL

1.1 DEFINITIONS

- A. Design Position: The location of the centroid of the pile at cutoff elevation (x, y, and z coordinates) as shown.
- B. Elevations: Referenced to the North American Vertical Datum of 1988 (NAVD 88).
- C. Fixed Leads: Leads that are pinned to crane boom at top and equipped with hydraulic spotter at bottom capable of spotting pile to its correct position and maintaining alignment during driving. Degree of rigidity and strength acceptable will be subject to review of CONTRACTING OFFICER.
- D. High Strain Dynamic Testing (HSDT): See Section 02356, DYNAMIC PILE TESTING.
- E. Impact Stress: See Section 02356, DYNAMIC PILE TESTING.
- F. Obstruction: Sudden and significant increase of penetration resistance and deviation of pile out of tolerance resulting from encountering a subsurface or physical condition.
- G. Practical Refusal: Penetration resistance of at least 120 blows per foot for 3 continuous feet, 200 blows per foot for 1 foot, or 50 blows per inch for 2 consecutive inches, whichever comes first, and to continue driving pile would be impractical. These criteria apply only for hammer sizes and operation as specified.
- H. Rated Hammer Energy:
 - 1. Diesel Hammers: Product of rated stroke times ram weight.
 - 2. Air Hammers: Rated energy from manufacturer's literature.
- I. Restriking: Positioning driving train and driving already installed pile after some nominal waiting period (as specified) after initial installation. This definition applies to redriving piles selected by CONTRACTING OFFICER for determining appropriate driving criteria requirements or for checking pile integrity. Restriking may require mobilizing crane and driving train from one pile to another location at opposite ends of structure(s).
- J. Set: Pile penetration in inches per blow.

- K. Sweep: Deviation from straightness measured along two perpendicular faces of pile while not subject to bending forces.
- L. Swinging Leads: Pile driving leads that are not pinned at the top and do not have a hydraulic spotter to position the leads.
- M. Termination Penetration Resistance: Penetration resistance (blow count) at which driving may be terminated, as established by CONTRACTING OFFICER.
- N. Transferred Hammer Energy: See Section 02356, DYNAMIC PILE TESTING.

1.2 SUBMITTALS

- A. Administrative Submittals: Production pile driving schedule and sequence.
- B. Shop Drawings:
 - 1. Splice Design Details and Calculations:
 - a. Pre-Manufactured Splices: Manufacturer's recommendations for installation.
- C. Quality Control Submittals:
 - 1. Piling Installer Qualifications.
 - 2. Welder Qualifications and Certifications: Source and site welding.
 - 3. Manufacturer's Certification of Compliance: Manufactured Products.
 - 4. Certification of Calibration:
 - a. Pressure gauge for measuring air pressure (for air hammers) or chamber pressure (for closed end diesel hammers). Include correction data for hose losses if air pressure gauge is located away from hammer.
 - b. Include a chart for closed end diesel hammers that equates bounce chamber pressure to either equivalent stroke or energy.
 - 5. Proposed method(s) to align and maintain pile alignment, including type of leads to be used with details on methods and equipment to be used to measure alignment.
 - 6. Manufacturer's Specifications of Products, and Maintenance Manuals, for pile hammer and auxiliary equipment.
 - 7. Complete Pile Hammer Data Sheet, attached as Supplement to this

Specification. Refer to Part 3, Article SUPPLEMENTS.

8. Daily Log and Record: At end of each working day, submit two copies of each record for every pile constructed that day.

1.3 QUALIFICATIONS

- A. Piling Installer: Minimum of 5 years of past successful experience on 10 projects of steel pile installation.
- B. Source and Site Welders: Current qualification in proposed welding procedure(s) in accordance with AWS D1.1.

1.4 STORAGE AND HANDLING

- A. Do not subject piles to damage by impact bending stresses in transporting to and storing piles onsite.
- B. Store and handle piles such that corrosion protection coatings, if applied, will not be damaged.

1.5 SEQUENCING AND SCHEDULING

- A. Complete foundation excavation, construction of cofferdams or earth support systems prior to start of pile driving activity.
- B. Production Pile Driving: Begin after successful completion of testing as specified in Section 02356, DYNAMIC PILE TESTING, and after receiving verbal approval from CONTRACTING OFFICER.

PART 2 PRODUCTS

2.1 PILES

- A. Pipe Piles: Cylindrical pipe shells meeting the requirements for welded and seamless steel pipe piles of minimum size and manufactured to ASTM A252, Grade 2, as modified herein:
 1. Minimum outside diameter: 12.75 inches.
 2. Minimum wall thickness: 0.5 inch.
 3. Pile toe elevation: See General Structural Notes on the Drawings and discussion in this specification section.
- B. Indicator Piles: Test piles driven at production pile locations as specified and defined in Section 02356, DYNAMIC PILE TESTING. Indicator piles, if found acceptable to

CONTRACTING OFFICER, will be left in place as part of the foundations system of the permanent facility.

2.2 PILE SPLICES

- A. Meet requirements of AWS D1.1, and provide equal stress strain behavior in bending, tension, compression, and torsion as unspliced segments of pile.
- B. Pre-Manufactured: CONTRACTING OFFICER's prior approval required.

2.3 CONCRETE

- A. As specified in Section 701 of the Standard Specifications For Grade 51 Concrete.

2.4 PILE PLATES

- A. Furnish with each pipe pile.
- B. Size: 3/4-inch thick and diameter equal to outside diameter of pile, plus 1 inch.
- C. ASTM A36 grade steel.
- D. Mill Tolerance: Manufacturer's standard.

PART 3 EXECUTION

3.1 PILE DRIVING EQUIPMENT

- A. Pile Driving Hammer and Driving System:
 - 1. Air or diesel hammers capable of continuous operation at all fuel and/or trip valve settings, and not overstress or otherwise cause damage to pile during installation. Replace piling damaged by installation at no additional cost to the GOVERNMENT.
 - 2. Size and type to consistently deliver an effective dynamic energy sufficient to drive pile to required pile toe elevation of elevation 540 feet or lower and ultimate vertical pile capacity of 180 tons.
 - 3. Compressor/Boiler Capacity: Furnish with at least 10 percent greater than manufacturer's minimum requirement.
 - 4. Air Hammer Calibrated Pressure Gauge: Furnish and position on hammer side of all valves, no more than 100 feet of hose away from hammer inlet and located for easy observation.

5. Closed-End Diesel Hammer Calibrated Pressure Gauge: Furnish and position near ground level for easy observation.
 6. Minimum Hammer Rated Energy:
 - a. Air Hammers: 19.5 Ft-Kips.
 - b. Diesel Hammers: 19.5 Ft-Kips.
- B. Hammer Cushion/Capblock: Manufactured from stable and predictable material.
1. Manufacturer and Type:
 - a. Metex Corp; Aluminum-Micarta, Force 10.
 - b. Penn State Metal Fabricators; Aluminum and Conbest.
- C. Helmet: Seat onto pile and bear evenly and concentrically with minimum play upon pile.
- D. Pile Head: Free to rotate.
- E. Pile Driving Leads:
1. Degree of rigidity and strength acceptable will be subject to the CONTRACTING OFFICER's review.
 2. Fixed Leads: Provide with hydraulic spotter.
 3. Swinging Leads:
 - a. Driving Template: Capable of maintaining alignment and position of leads and pile during driving within tolerances specified herein.
 - b. Of sufficient length so that lowering the leads during driving is not necessary.
 4. Of sufficient length so use of follower is not necessary.
 5. Straight and parallel, not deviating from straight line by more than 1/2 inch over 15-foot length.
 6. Easily adjustable to permit axial driving without interruption if piles deviate from their required alignment.

3.2 PREPARATION

- A. Make allowance for upheaval of excavation bottom due to driving.
- B. Use templates or other suitable methods to ensure required degree of accuracy.
- C. Do not drive piles within 200 feet of structural concrete less than 7 days old.

3.3 INSTALLATION

- A. Notify CONTRACTING OFFICER 7 days in advance of and perform driving in presence of CONTRACTING OFFICER.
- B. Welding: Meet requirements of AWS D1.1.
- C. Toe: Drive each pile toe using end plate. Attach end plate by means of continuous fillet weld around pile circumference.
- D. Splicing:
 - 1. Do not splice without CONTRACTING OFFICER present.
 - 2. Number: Maximum of three splices per pile.
 - 3. Spacing: Minimum 15 feet apart, unless otherwise approved by CONTRACTING OFFICER.
 - 4. Preparation: Square ends of both pile sections to be joined.
 - a. Tolerance: Pile ends shall not be out of square by more than 1/16 inch.
 - 5. Splices shall be full penetration butt weld.
 - 6. Spliced Pile: Straight, deviation in pile alignment shall be less than 1 inch in 50 feet.
- E. Pile Marking: At 1-foot intervals for purpose of recording driving resistance and depth of penetration of pile.
- F. Pile Driving:
 - 1. Perform in presence of CONTRACTING OFFICER.
 - 2. Maintain hammer concentric with driving train in axial alignment on pile. Do not use hammer to limit deviation of pile during driving by exerting lateral forces or striking at angle. Where pile orientation is essential, take special care to maintain orientation during driving.
 - 3. Impact driving may be terminated when a pile toe elevation of 540 feet (NAVD 88) is reached and required termination penetration resistance has been

obtained.

- a. After Effective Date of Agreement and within 30 days of receiving CONTRACTOR's Pile Hammer Data Sheet Submittal, CONTRACTING OFFICER will issue Preliminary Termination Penetration Resistance criteria. The Termination Penetration Resistance criteria issued shall be considered preliminary for use in driving test piles and shall be revised by the CONTRACTING OFFICER after completion of the pile testing.
 - b. CONTRACTING OFFICER will relate ultimate capacity to a penetration resistance (blow count) based on Wave Equation and CONTRACTOR's driving train, using information contained on Pile Hammer Data Sheet for Preliminary Termination Penetration Resistance and data from pile testing for Final Termination Penetration Resistance.
4. Provide means or device suitable to indicate penetration of piles, which is visible to CONTRACTING OFFICER at reasonable and safe distance from pile driver.
 5. Drive piles continuously, and without voluntary interruption, to elevation of 540 feet or lower and Final Termination Penetration Resistance.
 - a. Termination Penetration Resistance shall only apply after a toe elevation of 540 feet has been achieved.
 - b. If refusal driving resistance is obtained above minimum toe elevation, preboring, jetting, or other methods acceptable to CONTRACTING OFFICER may be required to advance pile.
 - c. Confer with and gain approval of CONTRACTING OFFICER before proceeding with alternative installation methods.
 - c. If termination penetration resistance is not achieved within 9 feet after reaching a pile toe elevation of 540 feet, discontinue pile driving and allow soil set-up to occur for a period of no less than 4 days. After soil set-up period, re-drive the pile a maximum of 1 additional foot in the presence of the CONTRACTING OFFICER and terminate driving. Record the blows per inch required to drive the pile for the 1 additional foot and provide copy of record to the CONTRACTING OFFICER.
 6. Specified rates of driving resistance shall not apply until set resulting from interruption in driving (such as stopping for field splice) or change in hammer cushion has been overcome, as determined by CONTRACTING OFFICER.
 7. Remove material forced up between piles above elevation shown for bottom of

foundation pit.

8. Redrive piles that are raised during process of driving adjacent piles.
9. Pulling piles into alignment or position will not be permitted.

G. Driving Tolerances:

1. Not more than 1 percent from vertical or 2 percent from batter shown.
2. Centroid of pile at cutoff elevation shall not vary from design position shown by more than 3 inches after driving.
3. If finished piling is not within driving tolerances, and an obstruction was not encountered during driving of the misaligned pile, the CONTRACTOR shall extract and reposition the pile, or pay for the CONTRACTING OFFICER to redesign the pile cap to accommodate the mispositioned pile. All work associated with repairing, redesigning, or replacing misaligned piling shall be accomplished at no additional cost to the GOVERNMENT.

3.4 PILE CUTOFF

- A. Cut square at required elevation with tools that will not damage area below cut surface.

3.5 OBSTRUCTIONS

- A. Notify CONTRACTING OFFICER immediately if obstructions are encountered during pile driving.
- B. If obstructions are encountered within the upper 15 feet of pile penetration, the pile shall be extracted, repositioned at a location as directed by the CONTRACTING OFFICER, and redriven.
- C. If pile damage is observed after extraction, replace the pile or the damaged portion to the satisfaction of the CONTRACTING OFFICER.
- D. If the pile is pulled and repositioned and encounters another obstruction in the upper 15 feet, confer with the CONTRACTING OFFICER as to how to remove or get past obstruction.
- E. Extracting, repositioning, and redriving shall be paid at the unit price shown in the Bid Schedule. Obstruction, damaged piles or portions of piles shall be paid at the unit price per lineal foot for piling installation shown in the Bid Schedule. Payment for removal of obstructions when authorized by the CONTRACTING OFFICER will be paid as extra work in accordance with the General Conditions.

3.6 FIELD QUALITY CONTROL

- A. Daily Log and Record: Document for each pile showing as a minimum:
1. Pile identification/location.
 2. Weather/groundwater conditions.
 3. Date and time start and complete driving.
 4. Respective depths of penetration.
 5. Pile toe and cutoff elevations.
 6. Driving resistance for each foot of driving over entire pile length.
 7. Equipment used.
 8. Installation method.
 9. Final pile head position (x, y, z (coordinates) after cut off indicating if pile is installed within the specified tolerances.
 10. Nature and location of obstructions encountered.
 11. Other pertinent pile driving behavior.

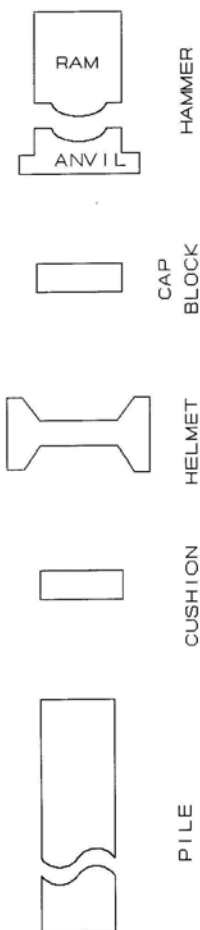
3.7 SUPPLEMENT

- A. The supplement listed below, following “END OF SECTION,” is a part of this Specification.
1. Hammer Data Sheet.

END OF SECTION 02365

HAMMER DATA SHEET

Contract No.:	Structure Name and/or No.:
Project:	
Pile Driving CONTRACTOR or Subcontractor:	
County:	Piles Driven By:



Manufacturer:	Model:
Type:	Serial No.:
Rated Energy: _____ @ _____ Length of Stroke	
Modifications: _____	
Material:	
Thickness:	Area:
Modulus of Elasticity - E (psi)	
Coefficient of Restitution - e	
ALL COMPONENTS	Weight:
Cushion Material:	
Thickness:	Area:
Modulus of Elasticity - E (psi)	
Coefficient of Restitution - e	
Pile Type:	Weight/ft
Length in Leads:	
Wall Thickness:	Taper:
Design Pile Capacity: (Tons)	
Description of Splice: _____	
Tip Treatment Description: _____	

NOTE: If mandrel is used to drive pile, attach separate manufacturer's detail sheet(s), including weight and dimensions.

Submitted By: _____ Date: _____

02365 SUPPLEMENT

SECTION 02372 - AUGER CAST PILES

PART 1 GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes drilled, auger cast piles.

Extent of auger cast piles is shown on drawings, including locations, diameters of shafts, estimated bottom elevations, top elevations, and details of construction.

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

Division 2 Section "Earthwork" for excavation.

Division 3 Section "Cast-In-Place Concrete" for concrete and related materials.

Division 5 Section "Structural Steel" for anchor bolts.

SYSTEM DESCRIPTION

Auger cast pile system shall consist of auger cast piles, pile reinforcement, and anchor bolts as shown on Drawings.

Drawings are based on assumed elevation of bottom of auger cast pile. If required, pile diameter and length will be modified by Contracting Officer based on recommendation of Testing Agency.

Payment for auger cast pile system will be based on quantities determined by Testing Agency and unit prices stated in Bid Form.

QUALITY ASSURANCE

Auger Cast Pile Installer Qualifications: Not less than three successfully completed contracts within the last 5 years with similar soil conditions, pile diameters, depths, and volumes to that contained in this Project. Submit satisfactory proof of compliance to Contracting Officer's Representative before beginning Work.

Survey Work: Contractor shall employ, at his expense, a surveyor, registered in State in which Project is located, to perform surveys, layouts, and measurements for auger cast pile Work.

Record and maintain information log of each auger cast pile and cooperate with Testing Agency to provide data for required reports.

Upon completion of Work, before construction continues, surveyor shall provide reproducible Record Foundation Drawing, corrected to conform with conditions existing after construction.

Show following on Record Drawing:

Exact location and top elevation of all auger cast piles at same scale and orientation as Drawings.

Note all auger cast piles which do not meet specified tolerances.

Do not continue with foundation Work until Contracting Officer's Representative has reviewed Record Drawing.

Testing Agency: Testing Agency will be independent testing laboratory employed by Contractor and approved by Contracting Officer.

Testing Agency is responsible for conducting, monitoring and reporting results of all tests required under this Section. Testing Agency has authority to reject materials not meeting Specifications.

Testing Agency shall observe all auger cast pile operations.

Responsibilities of Testing Agency:

Be present during all auger cast pile placement operations.

Keep Auger Cast Pile Log. Some data will be furnished by surveyor, but Testing Agency will complete log.

Confirm that each pile provides required capacity.

Confirm that each pile is at proper location.

Be present during all pile load tests.

CODES AND STANDARDS

American Society for Testing and Materials (ASTM). Comply with the following:

ASTM A615, "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement".

ASTM C33, "Specification for Concrete Aggregates".

ASTM C109, "Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)".

ASTM C150, "Specification for Portland Cement".

ASTM C618, "Specification for Fly Ash and Raw or Calcined Natural Pizzolan for Use as a Mineral Admixture in Portland Cement Concrete".

ASTM C937, "Specification for Grout Fluidifier for Preplaced- Aggregate Concrete".

ASTM D1143, "Method of Testing Piles Under Static Axial Compressive Load".

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Satisfactory proof of installer qualifications.

Record Foundation Drawing.

Auger Cast Pile Log: Submit Auger Cast Pile Log for each pile within 2 working days after completion of pile. Surveyor to provide items marked (s) to Testing Agency for inclusion in log. Include the following:

- Design diameter.
- Actual diameter. (s)
- Design elevation at bottom and top. (s)
- Actual elevation at bottom and top. (s)
- Design location of centerlines at top. (s)
- Actual location of centerlines at top. (s)
- Variation from plumb. (s)
- Starting and finishing times.
- Total replacement time.
- Time required for each foot of penetration.
- Grout mix design.
- Pressure used during grouting procedure.
- Volume of grout placed.
- Results of soil tests, if any.
- Any unusual conditions encountered.

Within 2 working days of day mortar cube testing is performed, submit to Contracting Officer's Representative the following information:

- Project name and location.
- Contractor's name.
- Testing Agency's name, address, and phone number.

Grout supplier.
Date of report.
Testing Agency technician's name (sampling and testing).
Location of pile(s).
Grout mix data (quantity and type):
 Cement.
 Fine aggregate.
 Mineral filler.
 Fluidifier.
 Other admixtures.
 Water.
Weather data:
 Air temperatures.
 Weather.
 Wind speed.
Compressive test data (7 day and 28 day):
 Cube number.
 Age of mortar when tested.
 Date and time of cube test.
 Curing time (field and lab).
 Compressive strength.

Dimensions shall be accurate to nearest 1/4 inch, except record elevations of pile bottoms shall be accurate to nearest inch.

Logs shall be prepared daily and jointly signed by Contractor, Testing Agency, and Surveyor.

Auger Cast Pile Load Tests: Testing Agency shall submit each test report within 2 working days of test.

Shop Drawings: Show all steel reinforcement, dowels, and anchor bolts cast in auger cast piles.

PROJECT CONDITIONS

Site Information: Data in subsurface investigation report was used for the basis of the design and is available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that neither Government nor Architect will be held responsible for interpretations or conclusions drawn from this data by Contractor.

Additional test borings and other exploratory operations may be performed by the Contractor, at the Contractor's option, however, no change in the Contract Sum will be authorized for such additional exploration.

Existing Utilities: Locate existing underground utilities by careful hand excavation before starting auger cast pile Work. If utilities are to remain in place, provide protection from damage during auger cast pile Work.

Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult Contracting Officer's Representative, immediately for directions as to procedure. Cooperate with Government, and public or private utility companies in keeping service and facilities in operation.

Do not interrupt existing utilities serving facilities occupied and used by Government and others, except when permitted in writing by Contracting Officer and only after acceptable temporary utility services have been provided.

SEQUENCING

Construct each auger cast pile continuously including placement of mortar and any steel reinforcement, dowels, or anchor bolts.

Do not interrupt sequence of operations for piles by weekends and holidays, or for any other reason, without approval of Contracting Officer.

UNIT PRICES

For purposes of bidding and measurement for payment, pile diameters, bottom elevations, top elevations, and reinforcement are shown on Drawings.

In Bid Form state:

Total number of pre-construction test piles upon which Bid is based.

Total number of structural piles upon which Bid is based.

Additional cost per lineal foot for installing more piling footage than indicated on Drawings.

Deducted cost per lineal foot for installing less piling footage than indicated on Drawings.

Additional cost per test pile for each additional test pile required due to no fault of Contractor.

Deducted cost per test pile for each deleted test pile.

PART 2 - PRODUCTS

MATERIALS

Cement Grout:

Portland Cement: ASTM C150.

AUGER CAST PILES

Pozzolan: ASTM C618, Class F.

Fluidifier: ASTM C937.

Water: Fresh, clean, and free from injurious amounts of sewage, oil, acid, alkali, salts, or organic matter.

Fine Aggregate: ASTM C33, fineness modulus between 1.30 and 2.10.

Steel Reinforcement: ASTM A615, Grade 60, continuous bars without splices.

CEMENT GROUT MIX DESIGN

Mortar shall consist of mixture of portland cement, fluidifier, fine aggregate, and water proportioned and mixed to produce mortar capable of maintaining solids in suspension without appreciable water gain, and which may be pumped without difficulty. Pozzolan may be used at piling contractor's option.

Materials shall be proportioned to have minimum 28-day strength of 4000 psi, ASTM C109.

Grout flow shall range between 15 and 35 seconds as measured by Flow Cone Method described in ASTM D-939.

PART 3 - EXECUTION

INSPECTION

Examine areas and conditions under which Work is to occur. Notify Contracting Officer's Representative immediately of all conditions detrimental to proper and timely completion of Work.

Proceed with Work only after unsatisfactory conditions have been acceptably remedied.

PREPARATION

Contractor shall establish building layout lines, temporary bench marks, and line and level of auger cast piles.

Contractor shall be entirely responsible for, and shall bear entire cost of, correcting all mislocated piles or incorrect cutoff levels at pile tops.

Locate Utilities: Cooperate with others to locate utility lines which might be cut or disturbed by pile operations.

Excavate pits near ends of lines to determine exact utility locations.

AUGER CAST PILES

Review proposed Work with all utilities, and arrange for removal, relocation, or disconnecting and capping of all lines.

Contractor has entire responsibility for costs incurred because of damage to utilities by his operations.

Before commencement of operations and after final Shop Drawings have been reviewed by Contracting Officer, arrange for representatives responsible for field procedures to meet with Contracting Officer, Architect, Contractor, and Testing Agency to finalize all procedures relating to auger cast pile operations.

INSTALLATION

Auger: Continuous-flight hollow-shaft with no gaps or breaks. Hollow shaft to be large enough to permit free passage of concrete grout, and discharge hole in hollow shaft shall be at bottom of auger below cutting teeth.

Flighting pitch not to exceed 9 inches.

Augers over 40 feet in length shall contain middle guide.

Stabilizing arm to prevent rotation of leads.

Grout Pump: Positive displacement piston type, displacing pressures up to 350 psi.

General: Temporary or permanent surfacing casing (Sonotube, etc.) shall be installed to depth of two (2) feet below gravel drain invert to preclude grout from entering drain system.

Rotate auger into ground to specified pile depth or refusal.

When auger has penetrated to required depth, grout shall be pumped through shaft under pressure at discharge of about 50 psi (minimum pressure reading of 200 psi at pump). Auger shall continue to be rotated slowly (3-5 RPM) in forward (digging) direction and then shall be slowly withdrawn, allowing grout under pressure to fill shaft and to penetrate laterally into any porous soils as auger is withdrawn. Auger shall not be allowed to advance ahead of grout and allow soils to cave into augered shaft such as may be detected by drop in pressure at pump. This procedure shall continue without break from bottom to top of piling. Reinforcement as required by plans shall be installed from top after placement of grout is completed and while grout is fluid with exception of center reinforcement bars where required which may be installed prior to pumping, through hollow auger stem.

Amount of grout placed in each piling shall be recorded and that amount shall not be less than theoretical volume of augered hole.

Obstructions: If any obstruction is encountered that prevents placing pile to depth required or causes pile to drift from required location, complete short pile as specified.

If required by Contracting Officer, additional adjacent pile shall be placed and paid for in

accordance with unit price for additional piling footage.

Refusal is defined as depth where penetration of standard augering equipment is 1 foot per minute or less.

Pile Tops: Where pile cutoff is near surface or above bottom of excavation, place metal sleeve or casing, of proper diameter and at least 18 inches in length, around pile top.

Tolerances: Install auger cast piles within following tolerances:

Deviation of centroid of top of pile from specified center in plan: 3 inches.

Deviation from plumb: 1 inch in 10 feet.

Variation of top from specified elevation: Plus or minus 1 inch.

FIELD QUALITY CONTROL

Inspection and Tests for Auger Cast Piles: Contractor shall employ a Testing Agency to perform full-time observation and testing services and report specified tests, prepare Auger Cast Pile Log, evaluate auger cast pile load tests, additional tests which may be required, and render a professional opinion. Conduct tests and report test results promptly in writing to Contractor, Architect, and Contracting Officer's Representative.

Representative of auger cast pile system installer, qualified to control field practices and whose experience shall include not less than three (3) years with augered pile foundation work, shall be available at all times to Contracting Officer for detailed control of procedures and quality.

Field Quality Control by Testing Agency:

Grout: 1 set of cubes, ASTM C109, each day piles are placed. Two (2) cubes tested at 7 days, two (2) cubes tested at 28 days, and two (2) cubes available for additional testing as required. Grout flow to range between 15 and 35 seconds as determined by Flow Cone Method, ASTM D-939.

Bearing Strata: Perform any required tests.

Test Piles: Supervise load tests.

Pre-construction Test Piles:

Provide 2 single piles, other than shown on Drawings, placed where directed by Testing Agency.

Perform load tests on these piles in accordance with ASTM D1143. Contractor to provide recently calibrated (within six months) hydraulic ram and pumping system, and provide and install load reaction system.

Testing Agency will supervise load tests.

Contracting Officer's Representative and Architect will be present at load tests.

END OF SECTION 02372

SECTION 02511 - HOT-MIXED ASPHALT PAVING

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes provisions for hot-mixed asphalt paving over prepared subbase.

Provide all material, labor, equipment, services and devices required to properly perform all machine-laid and hand-placed asphalt paving work.

Paint striping and marking is included in the Work of this Section.

Stabilized subgrade shall be prepared in accordance with Section 02200 - Earthwork. Subbase preparation and compaction shall be sequenced in such a manner to avoid undue exposure to the elements before placement of asphalt base.

Extent of asphalt concrete paving work is shown on drawings and consists of two-course paving and testing as specified herein.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

Test Reports: Submit following reports directly to Contracting Officer's Representative from the testing services, with copy to the General Contractor:

- Gradations
- Marshall Specimens
- Field Density and Thickness
- Asphalt Extraction
- Smoothness Test

QUALITY ASSURANCE:

Codes and Standards: Comply with Michigan Department of Transportation (MDOT) standard specifications, latest edition, and with local governing regulations if more stringent than herein specified.

Testing and Inspection Services: Employ, at Contractor's expense, a certified testing laboratory to perform pavement mix design and inspection service for quality control testing during paving operations.

SITE CONDITIONS

Weather Limitation: Apply prime and tack coats when ambient temperature is above 50 degrees F and when temperature has not been below 35 degrees F for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.

Construct hot-mixed asphalt surface course when atmospheric temperature is above 50 degrees F and when base is dry. Base course may be placed when air temperature is above 40 degrees F and rising.

Grade Control: Establish and maintain required lines and elevations.

PART 2 - PRODUCTS

MATERIALS

General: Use locally available materials and gradations that exhibit a satisfactory record of previous installations.

Mix design and materials shall comply with the following:

Base Course: Bituminous mix equal to MDOT Standard Specifications for Construction, latest edition. Mix 1100L. Thickness as shown on drawings.

Surface Course: Bituminous mix equal to MDOT Standard Specifications for Construction, latest edition. Mix 1100T. Thickness as shown on drawings.

In addition, the job design mixes shall meet the following Marshall design criteria requirements:

(1) Bituminous Base shall meet the following requirements:

Stability (mn)	1000
Flow	.05 to .12
% Voids	3 to 7
% Voids Filled	70 to 80

Minimum asphalt content shall be 4.5 percent of the dry weight of the aggregates.

(2) Asphaltic Concrete Wearing Surface shall meet the following requirements:

Stability (mn)	1500
Flow	.05 to .12
% Voids	3 to 7
% Voids Filled	70 to 85

Minimum asphalt content shall be 4.5 percent of the dry weight of the aggregates.

Not more than 25% recycled materials may be incorporated into the base course. No recycled materials shall be incorporated into the surface course.

Bituminous Materials: Bituminous materials for base course and surface course shall be Type AC-10 (AASHTO M226).

Tack Coat: Emulsified asphalt, ASTM D 977.

Lane Marking Paint: Alkyd-resin type, ready-mixed complying with AASHTO M 248.

Color: Yellow, white and blue. Refer to drawings.

PART 3 - EXECUTION

SURFACE PREPARATION

General: Remove loose material from compacted subbase surface immediately before applying herbicide treatment or prime coat.

Do not place paving over frozen subgrade.

Proofroll prepared subbase surface to check for unstable areas and areas requiring additional compaction.

Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.

Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into hot-mixed asphalt pavement. Distribute at rate of 0.05 to 0.15 gal. per sq.yd. of surface.

Allow to dry until at proper condition to receive paving.

Exercise care in apply bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.

CONSTRUCTION

HOT-MIXED ASPHALT PAVING

Construction shall only take place when conditions are dry. Areas of completed base damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specific requirements.

Transportation of bituminous mixture from mixing plant to site shall be in trucks having tight, clean, smooth beds coated with the least quantity of concentrated solution of hydrated lime and water to prevent adhesion of mixture to truck bodies. Each load of mixture shall be covered with canvas, or other suitable material, of ample size to protect mixture from weather and to prevent loss of heat. Deliveries shall be scheduled so that spreading and rolling of all mixture prepared for one day's run can be completed during daylight unless adequate artificial lighting is provided. Mixture shall be delivered in such manner that temperature at time of dumping into spreader will be not below specified requirements. Loads that have crusts of cold, unworkable material or have become wet by rain will be rejected. Hauling over freshly placed material will not be permitted.

PLACING MIX

General: Place hot-mixed asphalt mixture on prepared surface, spread, and strike off. Spread mixture at minimum temperature of 225 degrees F (107 degrees C). Place areas inaccessible to equipment by hand. Place each course to required grade, cross-section, and compacted thickness.

Pavement Placing: Place in strips not less than 10 feet wide, unless otherwise acceptable to Contracting Officer. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.

Maximum lift thickness for individual base courses shall be 4 inches.

Immediately correct surface irregularities in finish course behind paver. Remove excess material forming high spots with shovel or lute.

Surface course shall not be placed until heavy construction operations have been completed and project is near Substantial Completion unless otherwise acceptable to Contracting Officer.

Joint: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of hot-mixed asphalt course. Clean contact surfaces and apply tack coat.

Joints between successive lifts shall be offset a minimum of 1 foot.

Tack Coat: Immediately before applying tack coat, all loose material, dirt, clay, or other objectionable material shall be removed from surface to be treated with power broom or blower, supplemented with hand brooms. After cleaning operation and prior to application of the tack coat, inspect area to be treated to determine fitness of area to receive bituminous coating. The surface prepared for immediate treatment shall be dry and in a satisfactory condition. Apply to base course before application of surface course. Distribute at rate of 0.05 to 0.15-gallon per square yard of surface.

ROLLING

General: Begin rolling when mixture will bear roller weight without excessive displacement.

Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

Compaction of base course shall be at least 94 percent of lab molded density.

Compaction of surface course shall be at least 96 percent of lab molded density.

Speed of the roller shall be governed to avoid displacement or rippling of hot mixture. Rolling shall be continuous until all roller marks are eliminated. Roller shall weigh not less than 100 pounds to the inch width of tread and shall be operated by competent and experienced roller operators.

Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling, if required, with hot material.

Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been evenly compacted.

Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained specified density.

Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot hot-mixed asphalt. Compact by rolling to specified surface density and smoothness.

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

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

TRAFFIC AND LANE MARKINGS

Cleaning: Sweep and clean surface to eliminate loose material and dust.

Striping: Use traffic lane-marking paint, factory-mixed, quick-drying, and non-bleeding.

Do not apply traffic and lane marking paint until layout and placement have been verified with Contracting Officer's Representative. Apply paint with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide minimum 12 to 15 mils dry thickness.

FIELD QUALITY CONTROL

General: Test in-place hot-mixed asphalt courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Contracting Officer.

Testing: Unless otherwise specified, tests shall be conducted in accordance with the latest standards of American Society for Testing Materials or AASHTO, as applicable.

All testing shall be done at the Contractor's expense by an approved testing laboratory. Samples shall be taken by the laboratory. Make the following tests for each day of production:

Gradations:	One Test
Marshall Specimens:	One set (3 specimens per set).
Field Density and Thickness:	Cores through surfacing and base (core hole shall be filled), 4 tests total.
Asphalt Extraction:	One test.

Smoothness test shall show, on the surface of each layer, any deviations in excess of 3/8-inch when tested with a 10-foot straightedge applied both parallel with and at right angles to centerline of the paved area. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting, as directed.

Replacement Sections: Areas not capable of being corrected by heating and re-rolling shall be removed and be rectangular in shape and completely enclosing the area to be corrected, with sides parallel or perpendicular with pavement edges. Skim patching is not permitted.

Additional tests shall be required at the Contractor's expense for areas not conforming to the approved job mix formula as determined by Contracting Officer.

END OF SECTION 02511

SECTION 02515 - UNIT PAVERS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Division 1 Specification sections, apply to this Section.

SUMMARY

This Section includes the following:

UngROUTED mortarless brick pavers.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product data for the following products:

Brick pavers.

Samples for verification purposes in full-size units of each type of unit paver indicated, in sets for each color, texture, and pattern specified, showing full range of variations expected in these characteristics.

QUALITY ASSURANCE

Single-Source Responsibility: Obtain each color, type, and variety of unit pavers, from a single source with resources to provide products and materials of consistent quality in appearance and physical properties without delaying progress of the Work.

DELIVERY, STORAGE, AND HANDLING

Protect unit pavers during storage and construction against wetting by rain, snow, or ground water and against soilage or contamination from earth and other materials.

PROJECT CONDITIONS

Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

PART 2 - PRODUCTS

COLORS AND TEXTURES

Provide materials and products that result in colors and textures of exposed unit paver surfaces and joints complying with the following requirements:

Match existing brick pavers as acceptable to Contracting Officer.

UNIT PAVERS

Brick Pavers: Paving brick consisting of solid (uncored), unfrosted brick of sizes indicated, complying with requirements of ASTM C 902 for the following end-use environments (weather and traffic) and application method:

Weather Class SX.

Traffic Type I.

Application PX.

EDGE RESTRAINTS

Concrete for Job-Built Edge Restraints: Comply with requirements of Division 2 Section "Exterior Portland Cement Concrete" for concrete.

UNGROUTED MORTARLESS SETTING MATERIALS FOR BRICK PAVERS

Sand for Leveling Course: Fine aggregate complying with ASTM C 33.

Sand for Joints: ASTM C 144 except use aggregate graded with 100 percent passing the No. 8 sieve and 95 percent, the No. 16 sieve.

PART 3 - EXECUTION

EXAMINATION

Examine surfaces indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of unit pavers. Do not proceed with installation until satisfactory conditions have been corrected.

PREPARATION

Clean concrete substrates to remove dirt, dust, debris, and loose particles.

INSTALLATION, GENERAL

Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible or cause staining in finished work.

Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

Joint Pattern: As indicated below:

Lay unit pavers in joint pattern shown.

Handtight Joints: Where unit pavers are indicated without spaced joints, set unit pavers with hand-tight joints.

Tolerances: Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) and a tolerance of 1/8 inch in 2'0" and 1/4-inch in 10'0" from level or slope as indicated, for finished surface of paving.

Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Sealant materials and installation are specified in Division 7 Section "Joint Sealers."

Provide edge restraints as indicated. Install edge restraints prior to placing unit pavers.

UNGROUTED MORTARLESS BRICK PAVER APPLICATIONS

Place sand leveling bed where indicated. Compact by tamping or wetting and screed to depth indicated or required to allow for setting of brick pavers.

Set brick pavers in pattern indicated, placing as closely together as possible. Sweep fine sand over surface to fill joint irregularities.

REPAIR, POINTING, CLEANING, AND PROTECTION

Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment to eliminate evidence of replacement.

Provide final protections and maintain conditions in a manner acceptable to Installer, which ensures unit paver work being without damage or deterioration at time of Substantial Completion.

END OF SECTION 02515

UNIT PAVERS

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SECTION 02521 - CONCRETE CURBS, SIDEWALKS AND PAVEMENTS

PART 1 GENERAL

1.1 DEFINITIONS

- A. Standard Specifications: 1996 Standard Specifications for Construction, Michigan Department of Transportation.

1.2 SUBMITTALS

- A. Shop Drawings:

1. Form Material: Information on metal forms, if used, including type, condition, surface finish, and intended function.
2. Complete data on concrete mix, including aggregate gradations and admixtures in accordance with requirements of ASTM C94.
3. Jointing plan for concrete pavements.

- B. Quality Control Submittals:

1. Curing Compound: Manufacturer's Certificate of Compliance and application instructions.
2. Ready-mix delivery ticket for each truck in accordance with ASTM C94.

1.3 QUALITY ASSURANCE

- A. Conform to Standard Specifications.

PART 2 PRODUCTS

2.1 CONCRETE

- A. As specified in Section 03301, REINFORCED CONCRETE.

2.2 EXPANSION JOINT FILLER

- A. As specified in Section 03301, REINFORCED CONCRETE.

2.3 JOINT SEALANT

- A. Preformed Joint Seals for Concrete Construction as specified in Section 914.04D of the Standard Specifications.

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2.4 CURING COMPOUND

- A. Liquid membrane-forming, clear or translucent, suitable for spray application and meeting ASTM C309, Type 1.

PART 3 EXECUTION

3.1 FORMWORK

A. Lumber Materials:

1. 2-inch dressed dimension lumber, or metal of equal strength, straight, free from defects that would impair appearance or structural quality of completed curb and sidewalk.
2. 1-inch dressed lumber or plywood may be used where short-radius forms are required.

B. Metals: Steel in new undamaged condition.

C. Setting Forms:

1. Construct forms to shape, lines, grades, and dimensions.
2. Stake securely in place.

D. Bracing:

1. Brace forms to prevent change of shape or movement resulting from placement.
2. Construct short-radius curved forms to exact radius.

E. Tolerances:

1. Do not vary tops of forms from gradeline more than 1/8-inch when checked with 10-foot straightedge.

2. Do not vary alignment of straight sections more than 1/8-inch in 10 feet.

3.2 PLACING CONCRETE

- A. Prior to placing concrete, remove water from excavation and debris and foreign material from forms.
- B. Place concrete as soon as possible, and within 1-1/2 hours after adding cement to mix without segregation or loss of ingredients, and without splashing.
- C. Place concrete as specified in Section 03301, REINFORCED CONCRETE.

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- D. To compact, vibrate until concrete becomes uniformly plastic.

3.2 CURB CONSTRUCTION

- A. Comply with Section 802 of the Standard Specifications and details as shown. If requirements differ from those specified herein, the more stringent shall govern.
- B. Construct ramps at locations as shown on the Plans.
- C. Expansion Joints: Place at maximum 45-foot intervals and at the beginning and end of curved portions of curb, and at connections to existing curbs. Install expansion joint filler at each joint.
- D. Curb Facing: Do not allow horizontal joints within 7 inches from top of curb.
- E. Contraction Joints:
 1. Maximum 15-foot intervals in curb.
 2. Provide open joint type by inserting thin, oiled steel sheet vertically in fresh concrete to force coarse aggregate away from joint.
 3. Insert steel sheet to full depth of curb.
 4. Remove steel sheet with sawing motion after initial set has occurred in concrete and prior to removing front curb form.

5. Finish top of curb with steel trowel and finish edges with steel edging tool.
- F. Front Face:
1. Remove front form and finish exposed surfaces when concrete has set sufficiently to support its own weight.
 3. Finish formed face by rubbing with burlap sack or similar device to produce uniformly textured surface, free of form marks, honeycomb, and other defects.
 4. Remove and replace *defective* concrete.
 5. Apply curing compound to exposed surfaces of curb upon completion of finishing.
 6. Continue curing for minimum of 5 days.
- F. Backfill curb with earth upon completion of curing period, but not before 7 days has elapsed since placing concrete.
1. Backfill shall be free from rocks 2 inches and larger and other foreign material.
 2. Compact backfill firmly.

3.4 SIDEWALK CONSTRUCTION

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- A. Comply with Section 803 of the Standard Specifications and details as shown. If requirements differ from those specified herein, the more stringent shall govern.
- B. Thickness:
1. 4 inches in walk areas.
 2. 6 inches in driveway areas.
- C. Expansion Joints: Place in adjacent curb, where sidewalk ends at curb, and around posts, poles, or other objects penetrating sidewalk. Install expansion joint filler at each joint.
- D. Contraction Joints:
1. Maximum 7-1/2 feet.

2. Provide transversely to walks at locations opposite contraction joints in curb.
3. Dimensions: 3/16-inch by 1-inch weakened plane joints.
4. Construct straight and at right angles to surface of walk.

E. Finish:

1. Broom surface with fine-hair broom at right angles to length of walk and tool at edges, joints, and markings.
2. Mark walks transversely at 5-foot intervals with jointing tool; finish edges with rounded steel edging tool.
3. Apply curing compound to exposed surfaces upon completion of finishing.
4. Protect sidewalk from damage and allow to cure for at least 7 days.

3.5 CONCRETE PAVEMENT CONSTRUCTION

- A. Comply with Section 602 of the Standard Specifications and details as shown. If requirements differ from those specified herein, the more stringent shall govern.
- B. Expansion Joints: Place at locations where pavement slabs abut building construction. Install expansion joint filler at each joint.
- C. Contraction Joints:
 1. Provide jointing plan for review.
 2. Dimensions: 3/16-inch by 1-inch weakened plane joints.
 3. Construct straight and at right angles to adjacent features.

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CONCRETE CURBS,
SIDEWALKS AND PAVEMENTS

- D. Construction Joints: As specified in Section 03301, REINFORCED CONCRETE.
- E. Finish: As specified in Section 03301, REINFORCED CONCRETE.

END OF SECTION 0521

SECTION 02660 - PRESSURE WATER DISTRIBUTION SYSTEM PIPING

PART 1 GENERAL

1.1 SCOPE

- A. This section covers buried water distribution system piping, including piping under the building footprint. See Section 15060, PIPING—GENERAL, for water distribution piping inside the building.

1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:
 - 1. American National Standards Institute/American Water Works Association (ANSI/AWWA):
 - a. C104/A21.4, Cement-Mortar Lining for Ductile Iron Pipe and Fittings.
 - b. C110/A21.10, Gray Iron and Ductile Iron Fittings 3 Inches Through 48 Inches for Water and Other Liquids.
 - c. C111/A21.11, Rubber Gasket Joints for Cast Iron Pressure Pipe and
 - d. Ductile Iron Pressure Pipe and Fittings.
C151/A21.51, Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
 - e. C153/A21.53, Ductile Iron Compact Fittings 3 Inches Through 16 Inches, for Water or Other Liquids.
 - 2. American Society for Testing and Materials (ASTM):
 - a. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware (R1987).
 - 3. American Water Works Association (AWWA):
 - a. C111/A21.11, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

1.3 DEFINITIONS

- A. Buried Piping: Underground in trenches and backfilled.
- B. Encased Piping: Encased in concrete underground and backfilled.
- C. Embedded Piping: Embedded in the walls or slabs of concrete structures.

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- D. Exposed Piping:
 - 1. Above ground.
 - 2.
 - 2. Inside structures including vaults.

1.4 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Manufacturer's Certification of Compliance.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01600, MATERIAL AND EQUIPMENT, and:
 - 1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
 - 2. Cement Linings and Coatings: AWWA C205, Section 6. Pipe ends shall be tightly closed with a 10-mil polyethylene plastic wrap for protection of the cement-mortar lining during shipment. Keep plastic wrap on the pipe until the time of installation.
 - 3. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
 - 4. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.
 - 5. Rubber Gaskets:

- a. Store in a cool, well-ventilated area.
- b. Do not expose to the direct rays of the sun.
- c. Do not allow contact with oils, fuels, or petroleum solvents.

PART 2 PRODUCTS

2.1 PIPING

- A. As specified on Data Sheet(s).
- B. Diameters Shown:
 - 1. Standardized Products: Nominal size.

2.2 JOINTS

- A. Thrust Tie Assemblies:
 - 1. Tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.
 - 2. Anchoring of retainer glands or thrust ties with set screws is unacceptable.
- B. Mechanical Joint Anchor Gland Follower:
 - 1. Ductile iron anchor type, wedge action, with breakoff tightening bolts.
 - 3. Manufacturer and Product: EBAA Iron Inc.; Megalug.

2.3 COUPLINGS

- A. Flexible Couplings:
 - 1. Manufacturers and Products:
 - a. Ductile Iron Pipe: 1) Dresser; Style 153. 2) Smith-Blair; Style 411.
- B. Transition Couplings:
 - 1. Manufacturers and Products:
 - a. Dresser; Style 162.

b. Smith-Blair; Style 413.

C. Flanged Coupling Adapters:

1. Manufacturers and Products:

a. Ductile Iron Pipe: 1) Smith-Blair; Series 912. 2) Dresser Industries, Inc.; Style 127.

D. Bolting:

1. Exposed and Concrete-Encased Installations: Zinc-plated nuts and bolts; however, high-strength, low-alloy steel, in accordance with AWWA C111/A21.11, may be substituted for use on cast iron and ductile iron couplings.
2. Buried and Submerged Installations: Provide Type 304 stainless steel bolts and nuts.

2.4 ANCILLARY MATERIALS

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A. Gasket Lubricant: As supplied by pipe manufacturer; no substitute or “or-equal” will be allowed.

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B. Thrust Block Concrete: As specified in Section 03301, REINFORCED CONCRETE.

2.5 POLYETHYLENE ENCASEMENT

A. Polyethylene encasement shall conform to the requirements of ANSI A21.5 (AWWA C105). Only tubes shall be used.

2.6 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Ductile Iron Wall Pipe:

1. Diameter and Ends: Same as connecting ductile iron pipe.
2. Thickness: Equal to or greater than remainder of pipe in line.
3. Fittings: In accordance with the applicable Data Sheet.
4. Provide taps for stud bolts in flanges set flush with wall face.
- .5. Seep Ring:
 - a. Provide for wall pipes to prevent water seepage.
 - b. Material and Construction: 1) Ductile iron cast integral with wall pipe wherever possible. 2) Fabricate by welded attachment of ductile iron seep ring to

pipe where casting impossible. a) Perform in pipe manufacturer's shop by qualified welders as specified herein. b) Welds: Electric arc welds of ductile iron with NI-55 or FC-55, nickel-iron-carbon weld rod. c) Continuously weld on each side all around.

6. Manufacturer: American Cast Iron Pipe Co.

B. Pipe Sleeves: Fabricate of 3/16-inch minimum thickness steel pipe.

1. Abovegrade in Nonsubmerged Areas: ASTM A153 Hot-dip galvanized after fabrication.
2. Belowgrade or in Submerged or Damp Environments: Lined and coated after fabrication with System No. 2 as specified in Section 09900, PAINTING AND PROTECTIVE COATINGS.
- .3. Seep Ring:
 - a. Provide 3/16-inch minimum thickness center flange for water stoppage on sleeves in exterior or water-bearing walls.
 - b. Continuously fillet weld on each side all around.
4. Existing Walls: Holes drilled with a rotary drill may be provided in lieu of sleeves.

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C. Modular Mechanical Seal:

1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
2. Assemble interconnected rubber links with Type 316 stainless steel bolts, nuts, and pressure plates.
3. Size modular mechanical seals according to manufacturer's instructions for the size of

pipes shown to provide a watertight seal between pipe and wall sleeve opening.

.2.7 INSULATING FLANGES, COUPLINGS, AND UNIONS

.A. Dielectric Flange and Union Manufacturers:

1. 1. Epco Sales, Inc.
2. 2. Capitol Insulation Unions.

.B. Insulating Coupling Manufacturers:

1. 1. Dresser; STAB-39.
2. 2. R. H. Baker; Series 216.
2. 2.8 FINISHES

- A. Factory prepare, prime, and finish coat in accordance with Data Sheet(s) and Piping Schedule.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.
- B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

3.2 PREPARATION

- A. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.
- B. Furnish feeler gauges of the proper size, type, and shape for use during installation for each type of pipe furnished.

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3.3 INSTALLATION-GENERAL

- A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
- B. Inspect pipe and fittings before installation, clean ends thoroughly, remove foreign matter and dirt from inside.

C. Couplings:

1. Install in accordance with manufacturer's written instructions.

- .a. Metallic Piping Systems: Flexible couplings, transition couplings, and flanged coupling adapters specified.
- .b. Nonmetallic Piping Systems: Teflon bellows connector.
- .c. Concrete Encased Couplings: Sleeve type coupling.

2. Installation:

- .a. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
- .b. Clean gaskets before installation.
- .c. If necessary, lubricate with gasket lubricant for installation on pipe ends.
- .d. Tighten coupling bolts progressively, drawing up bolts on opposite sides a little at a time until all bolts have uniform tightness.

D. Insulating Flanges, Couplings, and Unions:

- 1. 1. Install between copper and ferrous metal piping connections and where shown.
- 2. 2. Drill flanges oversize to accommodate insulating sleeves through the drilling using standard bolt sizes.

E. Penetrations:

1. Watertight Penetrations:

- .a. Provide wall pipes with thrust collars.
- .b. Provide taps for stud bolts in flanges to be set flush with wall face.

2. Nonwatertight Penetrations:

- .a. Pipe sleeves with seep ring.
- .b. Pipe sleeves with modular mechanical seal may be provided where fabrication of seep ring on pipe sleeve is impractical.

3. Existing Walls:

- .a. Pipe sleeve with modular mechanical seal.
- .b. Rotary drilled holes may be provided in lieu of sleeves in concrete walls.

4. New Concrete Walls:

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- .a. Isolate embedded metallic piping from concrete reinforcement using coated pipe penetrations as specified in Section 09900, PAINTING AND PROTECTIVE COATINGS, System No. 27.
- .b. Support wall pipes securely by form work to prevent contact with reinforcing steel and tie

wires.

F. Ductile Iron Piping:

1. 1. Cutting Pipe: Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut.
- .2. Dressing Cut Ends:
 - .a. General: As required for the type of joint to be made.
 - .b. Rubber Gasketed Joints: Remove sharp edges or projections.
 - .c. Push-On Joints: Bevel, as recommended by pipe manufacturer.
 - .d. Flexible Couplings, Flanged Coupling Adapters, and Grooved End Pipe Couplings: As recommended by the coupling or adapter manufacturer.

3.4 INSTALLATION-BURIED PIPE

A. Joints:

1. Dissimilar Buried Pipes:
 - a. Provide flexible mechanical compression joints for pressure pipe.
2. Concrete Encased or Embedded Pipe: Do not encase joints in concrete unless specifically shown.

B. Placement:

1. 1. Keep trench dry until pipe laying and joining are completed.
2. 2. Pipe Base and Pipe Zone: As specified in Section 02225, TRENCH BACKFILL.
3. 3. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
4. 4. Measure for grade at pipe invert, not at top of pipe.
5. 5. Excavate trench bottom and sides of ample dimensions to permit proper joining, visual inspection, and testing of entire joint.
6. 6. Prevent foreign material from entering pipe during placement.
7. 7. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
8. 8. In general, lay pipe upgrade with bell ends pointing in direction of laying.
9. 9. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:

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- .a. Shorter pipe lengths.
- .b. Standard or special fabricated bends.

1. 10. Check gasket position with feeler gauge furnished by the pipe manufacturer, to assure proper seating.
2. 11. After joint has been made, check pipe alignment and grade.
3. 12. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
4. 13. Prevent uplift and floating of pipe prior to backfilling.

C. Tolerances:

1. 1. Deflection From Horizontal Line: Maximum 2 inches.
2. 2. Deflection From Vertical Line: Maximum 1/2 inch.
3. 3. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.
4. 4. Horizontal position of pipe centerline on alignment around curves maximum variation of 1 foot from position shown.
5. 5. Pipe Cover: Minimum 5 feet, unless otherwise shown.

3.5 THRUST RESTRAINT

- A. Location: At pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist.
- B. Thrust Ties: Anchoring of retainer glands or thrust ties with set screws is unacceptable.
- C. Mechanical Joint Valve Restraint in Proprietary Restrained Joint Piping: Install pipe joint manufacturer's adapter gland follower and pipe end retainer, or thrust tie-rods and socket clamps.

D. Thrust Blocking:

1. 1. Quantity of Concrete: Sufficient to cover bearing area on pipe and provide required soil bearing area as shown.
 2. 2. Place blocking so that pipe and fitting joints will be accessible for repairs.
 3. 3. Place concrete in accordance with Section 03301, REINFORCED CONCRETE.
- E. Mechanically restrained joints, if used in lieu of concrete thrust blocking at the CONTRACTOR's option, shall be as specified in the Data Sheets.

3.6 POLYETHYLENE ENCASEMENT

- A. Install polyethylene encasement on all buried piping, unless directed otherwise by the CONTRACTING OFFICER. Install in accordance with pipe manufacturer's instructions and in a manner to ensure a watertight connection between adjacent polyethylene tubes. Allow slack at pipe joints to eliminate breakage of the polyethylene during trench backfill operations.

3.7 VENTS AND DRAINS

- A. Vents and drains at high and low points in piping required for completed system may or may not be shown.
- B. Install vents on high points and drains on low points of pipelines only where shown.

3.8 CLEANING

- A. Following assembly and testing, and prior to disinfection and final acceptance, flush pipelines with water at 2.5 fps minimum flushing velocity until foreign matter is removed.
- B. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.
- C. Disinfection: As specified in Section 02683, DISINFECTION OF WATER SYSTEMS.

3.9 FIELD QUALITY CONTROL

- A. Pressure Leakage Testing: As specified in Section 15992, PIPING LEAKAGE TESTING.

3.10 SUPPLEMENTS

- A. Data Sheets.

Number Title

-01 Cement-Mortar-Lined Ductile Iron Pipe and Fittings

END OF SECTION

SECTION 02660-01 CEMENT-MORTAR-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	Description
Pipe	Buried Pipe Using Push-On Joints (except as shown otherwise): ANSI/AWWA C111/A21.11 and ANSI/AWWA C151/A21.51, Grade 60-42-10, pressure class conforming to Tables 51.1 and 51.3 for Type 4 trench, 250 psi minimum working pressure.
Lining	Cement-Mortar: ANSI/AWWA C104/A21.4, double thickness.
Coating	Asphaltic: ANSI/AWWA C104/A21.4
Fittings	Lined and coated same as pipe. Push-On: ANSI/AWWA C110/A21.10 and C111/A21.11, gray or ductile iron, 250 psi minimum working pressure. American Cast Iron Pipe Co., Fastite Joint; U.S. Pipe and Foundry, Tyton Joint. Mechanical: ANSI/AWWA C110/A21.10, C111/A21.11, and C153/A21.53 gray or ductile iron, 250 psi minimum working pressure. Push-On Restrained: ANSI/AWWA C111/A21.11 and C153/A21.53, ductile iron, 250 psi minimum working pressure. Clow Corp., Super-Lock Joint; American Cast Iron Pipe Co., Flex-Ring or Lok-Ring Joint; U.S. Pipe, TR Flex.
Joints	Push-On: 250 psi minimum working pressure, ANSI/AWWA C110/A21.10 and C111/A21.11. American Cast Iron Pipe Co., Fastite Joint; U.S. Pipe and Foundry, Tyton Joint. Mechanical: 250 psi minimum working pressure. Push-On Restrained: 150 psi minimum working pressure. Clow Corp., Super-Lock; American Cast Iron Pipe Co., Flex-Ring or Lok-Ring; U.S. Pipe, TR Flex.
Bolting	Mechanical, Proprietary Restrained, and Grooved End Joints: Manufacturer's standard.
Gaskets	Push-On, Mechanical, and Proprietary Restrained Joints: Rubber conforming to ANSI/AWWA C111/A21.11. Gasket pressure rating to equal or exceed the system hydrostatic test pressure.
Joint Lubricant	Manufacturer's standard.

END OF SECTION

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DATA SHEET
CEMENT-MORTAR-LINED DUCTILE
IRON PIPE AND FITTINGS

SECTION 02662 - WATER SERVICE CONNECTIONS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society for Testing and Materials (ASTM):
 - a. B32, Standard Spec for Solder Metal.
 - b. B88, Seamless Copper Water Tube.

PART 2 PRODUCTS

2.1 COPPER TUBING

A. Size: 1-inch to 2-1/2-inch service connections.

B. Characteristics:

1. Type K, soft, seamless.
2. Conform to ASTM B88.
3. Commercially pure wrought copper solder joint fittings.
4. Joints:
 - a. 95-5 coreless wire solder.
 - b. Conform to ASTM B32, Grade 95 TA.

2.2 DUCTILE IRON PIPE

A. Size: 4-inch and larger service connections.

B. As specified for in Section 02660-01, CEMENT-MORTAR-LINED DUCTILE IRON PIPE AND FITTINGS.

2.3 SERVICE CONNECTION

A. Furnish components same size as nominal designation of service pipe. For example, 3/4-inch connection consists of:

1. 3/4-inch corporation stop,
2. 3/4-inch curb stop, or
3. 3/4-inch angle valve.
4. 3/4-inch meter couplings.

2.4 SERVICE SADDLES

2.5 CORPORATION STOPS

2.7 FLEXIBLE COUPLINGS

Service Size	Characteristics	Manufacturer & Model
3/4-inch through 1-1/2 inch	AWWA C800 thread inlet; compression connection for copper pipe outlet	Mueller: H-15000 or Hays: 5200
2-inch	Outside iron pipe thread inlet; compression connection for copper pipe outlet	Mueller: H-15025 or Hays: 5204
2-1/2 inch	Shall conform to AWWA C800	

2.6 COUPLINGS

Service Size
3/4-inch through 2-inch

Characteristics

Three-part union; copper-to-copper for connecting new copper service pipe to existing copper service pipe; other coupling as required to connect new copper service to existing other-than-copper pipe; compression connection outlet

Manufacturer & Model

Mueller: H-15400

A. Characteristics: Straight cast couplings.

B. Manufacturer: Smith-Blair; Model No. 441.

2.8 UNIONS

A. Characteristics: Copper-to-copper union.

B. Manufacturers:

1. Mueller Co.; Model H-15400.
2. Hays Manufacturing Co.; Model 5615.

2.9 MISCELLANEOUS FITTINGS

- A. Characteristics: Miscellaneous fittings, reducers, and adapters.
- B. Manufacturers:
 1. Mueller Co.
 2. Hays Manufacturing Co.

2.9 CURB STOPS

2.11 CURB BOXES

Service Size	Characteristics	Manufacturer & Model
1-inch through 2-inch	Conductive compressive connection	Mueller: H-15209
2-1/2 inch	Shall conform to AWWA C800	

- A. Characteristics:
 1. Furnish with lids and plugs.
 2. 5-1/2 feet long, extension type.
 3. Arch pattern base.
- B. Manufacturers: Mueller Co.; Model H-10310.

2.12 METER

- A. As specified in Section 15400, PLUMBING AND MISCELLANEOUS PIPING SYSTEMS.

PART 3 EXECUTION

3.1 GENERAL

- A. Install service connections, excluding meters, during or after construction of the main.
- B. Install water meters after entire water system is ready for operation.

- C. Depth of cover over the pipe shall be minimum 60 inches.

3.2 CONNECTION TO MAIN

- A. Clean exterior of main of dirt and other foreign matter that may impair the quality of the completed connection.
- B. Place service clamp at desired location.
- C. Clamp by tightening alternate nuts progressively.
- D. Do not place service clamp within 1-foot of pipe joint, or another clamp.
- E. Make taps with adapters for the size main being tapped.

3.3 COPPER TUBING

- A. Cut square ends, ream clean, and flare and make up tightly.
- B. Prevent the tube from kinking or buckling on short radius bends. If tube should kink or buckle, cut out kinked or buckled sections and splice with brass fitting.

3.4 METERS

- A. Meter to be installed inside buildings in accordance with Section 15400, PLUMBING AND MISCELLANEOUS PIPING SYSTEMS.

3.5 TESTING

- A. Test service connection and piping at the normal main pressure after main has been connected and pressure tested as specified in Section 15992, PIPE TESTING.
- B. Inspect service connections for leakage under normal system pressure. Joints shall be watertight before acceptance.
- C. Test Duration: At least 15 minutes.
- D. Inspect for leaks and repair before backfilling.

3.6 DISINFECTION OF SERVICE CONNECTIONS

- A. Following connection to the main:
 - 1. Close corporation stop and meter stop.
 - 2. Connect new copper tubing to existing copper tubing or to meter stop.
 - 3. Open corporation stop and allow to stand at main pressure for a minimum of 30 minutes.

4. Open meter stop.
- C. Extra chlorine will be put into the system by CONTRACTOR during service connection transfers to provide adequate disinfection capacity when above procedures are executed.

END OF SECTION 02662

SECTION 02683 - DISINFECTION OF WATER SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Water Works Association (AWWA):
 - a. B300, Hypochlorites.
 - b. B301, Liquid Chlorine.
 - c. B303, Sodium Chlorite.
 - d. C651, Disinfecting Water Mains.

1.2 QUALITY CONTROL SUBMITTALS

- A. Procedures and plans for disinfection and testing.
- B. Type of disinfecting solution and method of preparation.
- C. Training records for employees working with concentrated chlorine solutions or gas.
- D. Qualifications: Independent testing agency.
- E. Testing Agency:
 - 1. Equipment: Certified calibrations, manufacturer's product data, and test procedures.
 - 2. Sample Collection and Analysis Procedures for:
 - a. Bacteriological Samples.
 - b. Chlorine Samples.
- F. Certified Bacteriological Test Results:
 - 1. Facility(ies) tested is free from coliform bacteria contamination.

2. Forward results directly to CONTRACTING OFFICER.

G. Method of disposal for disinfecting wastewater.

1.3 QUALIFICATIONS

A. Independent Testing Agency: Certified in the State of Michigan, with 10 years' experience in the field of water sampling and testing required for this Project. Calibrated testing instruments and equipment, and documented standard procedures for performing specified testing.

PART 2 PRODUCTS

2.1 WATER FOR DISINFECTION

- A. Clean, uncontaminated, and potable.
- B. CONTRACTING OFFICER will supply potable quality water, CONTRACTOR shall convey in disinfected pipelines or containers.

2.2 CONTRACTOR'S EQUIPMENT

A. Furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.

2.3 MIXING DISINFECTANT

- A. Prepare "stock" solution by mixing any of following as described below. The purpose of the stock solution is to facilitate mixing and dilution to ensure a uniform disinfecting solution. The CONTRACTOR will not be required to mix a stock solution if a liquid chlorine gas feed system that can accurately feed a desired amount of chlorine to mix a final (dilute) disinfecting solution is used.
 - 1. Liquid chlorine gas conforming to AWWA B301 and water mixture.
 - 2. Dry chlorine gas conforming to AWWA B301.
 - 3. Calcium hypochlorite conforming to AWWA B300 or sodium hypochlorite conforming to AWWA B303 powder or liquid and water mixture.
- B. Feed dry chlorine gas through devices to regulate the rate of flow and ensure uniform diffusion of gas into water within the pipe or vessel being treated. Chlorinating devices for feeding chlorine gas solution or the gas itself shall prevent backflow of water into chlorine cylinder.
- C. Use following proportions of hypochlorite or chlorine to water:

1. Chlorine Gas or Liquid (100 Percent Cl): 1 pound per 11.75 gallons water.
 - a. Apply liquid chlorine gas-water solution by means of a solution feed chlorinating device.
2. Calcium Hypochlorite (65 to 70 Percent Cl): 1 pound per 7.5 gallons water.
 - a. If calcium hypochlorite is used, first mix dry powder with water to make a thick paste, then thin to a 1 percent solution (10,000 ppm chlorine).
3. Sodium Hypochlorite (5.25 Percent Cl): 1 gallon per 4.25 gallons water.
 - a. If sodium hypochlorite procedure is used, dilute the liquid with water to obtain a 1 percent solution.

PART 3 EXECUTION

3.1 GENERAL

- A. Disinfect pipelines, installed or modified under this Project, intended to hold, transport, or otherwise contact potable water:
 1. Disinfect new pipelines that connect to existing pipelines up to the point of connection.
 2. Disinfect surfaces of materials that will contact finished water, both during and following construction using spray method described below. Disinfect prior to contact with finished water. Take care to avoid recontamination following disinfection.
- B. Prior to application of disinfectants, clean pipelines of loose and suspended material. Flush pipelines until clear of suspended solids and color. Use water suitable for flushing and disinfecting.
- C. Allow freshwater and stock disinfectant solution to flow into the pipe or vessel at a measured rate so that the chlorine-water solution is at the specified strength. Do not place concentrated commercial disinfectant in the pipeline before it is filled with water.

3.2 PIPELINES

- A. The three 12-inch pipelines under the driveways do not require disinfection.
- B. Flushing:
 1. Before disinfecting, flush all foreign matter from pipeline. Provide hoses, temporary pipes, ditches, and other conduits as needed to dispose of flushing

water without damage to adjacent properties. Flushing velocities shall be at least 2.5 fps.

2. Flush pipelines through flushing branches and remove branches after flushing is completed. Operate valves during flushing process at least twice during each flush.
3. Flush service connections and hydrants. Flush distribution lines prior to flushing hydrants and service connections.

C. Disinfecting Solution: Chlorine-water solution having a free chlorine concentration of not less than 50 ppm.

D. Disinfecting Procedure: In accordance with AWWA C651, unless herein modified.

E. Point of Application:

1. Inject chlorine mixture into pipeline to be treated at beginning of line through corporation stop or suitable tap in top of pipeline.
2. Control water from existing system to flow slowly into pipeline during application of chlorine.
3. Control rate of chlorine solution flow in proportion to rate of water entering pipe so that combined mixture shall contain not less than 50 ppm of free available chlorine.
4. Prevent backflow of chlorine solution into line supplying water.

F. Retention Period:

1. Retain treated water in pipeline for at least 24 hours to destroy all nonspore-forming bacteria. At end of 24 hour period, disinfecting solution shall contain at least 10 ppm of free chlorine or the pipeline shall be recleaned, disinfecting solution shall be reapplied, and specified procedure repeated.
2. Operate valves, hydrants, and appurtenances during disinfection to ensure that disinfecting solution is dispersed into all parts of pipeline, including dead-ends and areas that otherwise may not be treated.
5. After disinfection, flush water from the permanent source until water through the pipeline is equal chemically and bacteriologically to permanent source of supply. Flushing of service connections after chlorination is required.

3.3 DISPOSAL OF DISINFECTING WASTEWATER

- A. Do not allow flow into a waterway without neutralizing disinfectant residual.

1. See AWWA C652 for acceptable neutralization methods.

3.4 TESTING

A. Test Equipment:

1. Clean containers and equipment used in sampling and assure they are free of contamination.
2. Obtain sampling bottles with instructions for handling from an independent testing laboratory.

B. Chlorine Concentration Sampling and Analysis:

1. Residual Free Chlorine Samples: 1 Sample.
2. Sampling Locations: Selected by CONTRACTING OFFICER.
3. Analysis to be performed by an independent test laboratory. Samples will be analyzed using the amperometric titration method for free chlorine as described in the latest edition of Standard Methods for Examination of Water and Wastewater.

C. After pipelines have been cleaned, disinfected, and refilled with potable water, CONTRACTOR will take water Samples and have them analyzed at approved independent laboratory for conformance to bacterial limitations for public drinking water supplies. Samples shall be analyzed for coliform concentrations in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater.

1. A minimum of two Samples on each of 2 consecutive days from each 2,000 feet of pipeline will be obtained and analyzed by standard procedures outlined by state and local regulatory agencies.
2. Sampling points will be representative as accepted by the CONTRACTING OFFICER.

D. Independent laboratory will be selected and retained by CONTRACTOR and approved by CONTRACTING OFFICER.

E. If the minimum Samples required above are not bacterially negative, the disinfecting procedures and bacteriological testing shall be repeated on the respective facilities until bacterial limits are met.

F. END OF SECTION 2683

SECTION 02700 - GRAVITY PIPING FOR STORM DRAIN AND SANITARY SEWER SERVICE CONNECTIONS

PART 1 GENERAL

1.1 SCOPE

- A. This section covers all project storm drain piping and the sanitary sewer service connection pipe from the main line to a point approximately 5 feet outside of the building wall. See Section 15060, PIPING—GENERAL, for building waste piping, including piping under the building footprint to the point of connection to the sanitary sewer service connection pipe. The two drawings titled, “Charter Township of Harrison Standard Sanitary Sewer Details” cover the sanitary sewer main line piping.

1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:
1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M36, Interim Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains.
 2. American Society for Testing and Materials (ASTM):
 - a. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - b. C150, Standard Specification for Portland Cement.
 - c. C443 REV A, Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
 - d. C497, Standard Test Methods for Testing Concrete Pipe, Manhole Sections, or Tile.
 - e. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 - f. D3034-89, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - g. D3212, Standard Specification for Joints for Drain and Sewer Plastic

Pipes Using Flexible Elastomeric Seals.

- h. F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

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1.3 SUBMITTALS

- A. Quality Control Submittals: Manufacturer's Certification of Compliance.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

- A. As specified in the Data Sheets following "END OF SECTION."

2.2 SANITARY SEWER SERVICE CONNECTIONS

- A. Pipe and fittings for individual sanitary sewer service connection shall be of one type of material throughout.
- B. Polyvinyl chloride pipe.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPE, FITTINGS, AND APPURTENANCES

- A. General:
 - 1. Pipe laying shall proceed upgrade with spigot ends pointing in direction of flow.
 - 2. Excavate bell holes at each joint to permit correct assembly and inspection of entire joint.
 - 3. Pipe invert may deviate from line or grade up to 1/2-inch for line and 1/4-inch for grade, provided that finished pipe line will present a uniform bore, and such variation does not result in a level or reverse sloping invert, or less than minimum slope shown.
 - 4. Pipe bedding shall form a continuous and uniform bearing and support for the pipe barrel between joints. Pipe shall not rest directly on the bell or pipe joint.

5. Prevent entry of foreign material into gasketed joints.
 6. Plug or close off pipes which are stubbed off for manhole, concrete structure, or for connection by others, with temporary watertight plugs.
- B. Concrete Closure Collars: Only use concrete closure collars where shown or authorized by CONTRACTING OFFICER.
- C. Service Connections:
1. Minimum Slope: 1/4-inch per foot.

3.2 PRESSURE TESTING

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- A. As specified in Section 15992, PIPING LEAKAGE TESTING.

3.3 REPAIR AND RETESTING

- A. Sections of pipe not meeting test requirements shall be replaced or have individual joints tested and sealed.
- B. Following repairs, sections shall be retested as specified.

3.4 SEWER CLEANING

- A. Prior to final acceptance and final manhole-to-manhole inspection of the sewer system by CONTRACTING OFFICER, flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.
- B. Upon CONTRACTING OFFICER's final manhole-to-manhole inspection of the sewer system, if any foreign matter is still present in the system, reflush and clean the sections and portions of the lines as required.

3.5 SUPPLEMENTS

- A. Data Sheets.

Number Title

-02 Corrugated Metal Pipe and Fittings -06 Polyvinyl Chloride
(PVC) Pipe and Fittings -10 Reinforced Concrete Pipe and Fittings

END OF SECTION 02700

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SECTION 02700-02 CORRUGATED METAL PIPE AND FITTINGS	
Pipe	AASHTO M36, Type I, galvanized
Coupling Bands Gaskets	Manufacturer's standard, with same protective coating as pipe. Manufacturer's standard.
Source Quality Control	In accordance with specified reference standard.

END OF SECTION 2700-02

SECTION 02700-06 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS	
Pipe: 15-inch diameter and under	ASTM D3034: Standard dimension ratio less than 35, except that the cell classification shall be 12454-B or 12454-C as defined in ASTM D1784.
Joints	ASTM D3212 rubber gasketed.
Gaskets	ASTM F477. Lubricants: As approved by manufacturer.
Fittings	PVC, gasketed. Provide plug when service piping is not required.
Plugs	Removable. Removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.
Source Quality Control Testing	In accordance with specified ASTM.

END OF SECTION -2700-06

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DATA SHEET
POLYVINYL CHLORIDE (PVC)
PIPE AND FITTINGS

SECTION 02721 - CATCH BASINS

PART 1 GENERAL

1.1 SUBMITTALS

- A. Shop Drawings: Precast Base, Cones, and Top Slab Sections: Details of construction.
- B. Quality Control Submittals:
 - 1. Precast Sections: Manufacturer's results of tests performed on representative sections to be furnished.

PART 2 PRODUCTS

2.1 PRECAST UNITS

- A. Riser Sections:
 - 1. Fabricate in accordance with ASTM C478-94.
 - 2. Minimum Wall Thickness: 4 inches or 1/12 times inside diameter, whichever is greater.
 - 3. Top and bottom shall be parallel.
 - 4. Joints: Tongue-and-groove or confined groove with mortar.
- B. Cone Sections:
 - 1. Provide eccentric cones.
 - 2. Same wall thickness and reinforcement as riser section.
- C. Base Sections and Base Slab:
 - 1. Base Sections: Base slab integral with sidewalls.
 - 2. Fabricate in accordance with ASTM C478-94.
- D. Manhole Extensions:
 - 1. Concrete grade rings; maximum 6 inches high.

2. Fabricate in accordance with ASTM C478-94.
- E. Preformed Plastic Gaskets: Hamilton Kent Manufacturing Co., Box 178, Kent, OH 44240, Kent-Seal No. 2.
- F. Source Quality Control:
1. All test specimens shall be mat tested and meet the permeability test requirements of ASTM C14-94.
 2. Conduct tests at point of manufacture prior to delivery of any section.
 3. Sections to be tested will be selected at random from stockpiled material to be supplied for the project.

2.2 FRAMES AND GRATES

A. Castings:

1. Tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.
2. Cast Iron: ASTM A48-94 Class 30B.
3. Plane or grind bearing surfaces to ensure flat, true surfaces.

B. Grate: True and seat within ring at all points.

C. Model as shown on Plans.

2.3 MORTAR

- A. Standard premixed in accordance with ASTM C387-87, or proportion 1 part portland cement to 2 parts clean, well-graded sand which will pass a 1/8-inch screen.
- B. Admixtures: May be included but do not exceed the following percentages of weight of cement:
1. Hydrated Lime: 10 percent.
 2. Diatomaceous Earth or Other Inert Material: 5 percent.
- C. Mix Consistency: Such that mortar will readily adhere to pipe and concrete.

2.4 BASE ROCK

- A. Granular fill as specified in Section 02220, FILL AND BACKFILL.
- B. Minimum 6 inches compacted thickness.

PART 3 EXECUTION

3.1 GENERAL

- A. Remove and keep all water clear from the excavation during construction and testing operations.
- B. Place base rock on undisturbed earth; thoroughly compact with a mechanical vibrating or power tamper.
- C. Joint type is CONTRACTOR's choice, i.e., mortar, preformed plastic gaskets or rubber gaskets.
- D. Completed catch basins shall be rigid and watertight.

3.2 EXCAVATION AND BACKFILL

- A. Excavation: As specified in Section 02205, EXCAVATION.
- B. Backfill: As specified in Section 02220, FILL AND BACKFILL, for the adjoining pipe trench.

3.3 INSTALLATION OF PRECAST CATCH BASINS

- A. Concrete Base and Wall Sections:
 - 1. Place on compacted base rock.
 - 2. Properly locate, ensure firm bearing throughout, and plumb first section.
 - 3. Thoroughly clean ends of sections to be joined.
- B. Mortar Joints:
 - 1. Thoroughly wet joint with water prior to placing mortar.
 - 2. Place mortar on groove of lower section prior to section installation.
 - 3. Fill joint completely with mortar of proper consistency.
 - 4. Trowel interior and exterior surfaces smooth on standard tongue-and-groove

joints.

5. Prevent mortar from drying out and cure by applying an approved curing compound or comparable approved method.
6. Do not use mortar mixed for longer than 30 minutes.
7. Chip out and replace cracked or defective mortar.

C. Preformed Plastic Gaskets:

1. Carefully inspect precast sections to be joined.
2. Do not use sections with chips or cracks in the tongue.
3. Use only pipe primer furnished by gasket manufacturer.
4. Install gasket material in accordance with manufacturer's instructions.

D. Rubber Gasketed Joints: Install in accordance with manufacturer's instructions.

E. Extensions:

1. Provide on structures in streets or other locations where a subsequent change in existing grade may be likely.
2. Install to height not exceeding 12 inches.
3. Lay grade rings in mortar with sides plumb and tops level.
4. Seal joints with mortar as specified for sections.

3.4 FRAMES AND GRATES

- A. Set frames in bed of mortar with mortar carried over flange as shown.
- B. Set tops of covers flush with surface of adjoining pavement or ground surface, unless otherwise shown or directed.

3.5 STRUCTURE TO PIPE CONNECTION

- A. Grout pipe to precast walls with mortar.
- B. Pipe joints to be no more than 3 feet outside structure wall.

3.6 FIELD QUALITY CONTROL

A. Hydrostatic Testing:

1. When, in CONTRACTING OFFICER's opinion, the groundwater table is too low to permit visual detection of infiltration leaks, hydrostatically test all of the project catch basins.
2. Procedure: Plug inlets and outlets and fill structure with water to height determined by CONTRACTING OFFICER.
3. A structure may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into the pipe walls to take place.
4. Leakage in each structure shall not exceed 0.1 gallon per hour per foot of head above the invert.
5. Repair structures that do not meet the leakage test, or do not meet specified requirements from visual inspection.

3.7 CLEANING

- A. Upon completion, clean each structure of all silt, debris and foreign matter.

END OF SECTION 02721

SECTION 02810 - UNDERGROUND IRRIGATION SYSTEM

PART 1 - GENERAL

Scope: This Section shall include labor, materials, equipment and services necessary to complete the installation of the irrigation system. The desired coverage of the irrigation system is shown on the drawings. The Contractor is to complete the piping and calculations necessary to make the system operable in compliance with local codes and regulations.

RELATED DOCUMENTS:

Drawings and general provisions of this Contract, including General and Division 1 Specification sections, apply to work of this section. The Contractor shall review the drawings and specifications to coordinate work of the Section with all other related work.

DESCRIPTION OF WORK:

Extent of underground irrigation system is shown on drawings.

QUALITY ASSURANCE:

Manufacturer Qualifications: Provide underground irrigation system as a complete unit produced by a single acceptable manufacturer, including heads, valves, controls, and accessories.

As Built Prints: The Contractor shall provide one set of reproducible "as built" drawings annotating all installation additions, changes, relocations, and/or corrections to the installation plan. These shall be carefully recorded and kept up to date throughout the progress of the job to completion of the project, whereupon they shall be returned to the Contracting Officer for a permanent record of this work.

Staking: The locations of the existing and proposed improvements shall be surveyed and staked by the Contractor. Plan dimensions and scaled distances on the plan shall be used. Discrepancies in the plan versus field layout shall be reported to the Contracting Officer for further direction.

SUBMITTALS:

Product Data: Submit manufacturer's technical data and installation instructions for underground sprinkler system for approval.

PART 2 - PRODUCTS

MATERIALS:

All materials and/or products shall be furnished and installed as named, or otherwise specified herein, with

the exception of substitutions accepted by the Contracting Officer under the conditions contained in these Specifications.

Mainline and Circuit Pipe: Comply with following:

PVC Pipe: All PVC pipe shall be Class 200, NSF, PVC, bell-end, solvent weld, with factory chamfered male ends, conforming to cell class 2345B, SDR21 or as noted on plans. The Contractor shall submit the manufacturer's name for approval to the Contracting Officer prior to placement of the plastic pipe order.

PVC Fittings: All fittings used for joining PVC pipe shall be Schedule 40 (except threaded nipples shall be Schedule 80 PVC) NSF, PVC, solvent weld, with factory imprint showing size and type.

Swing Riser Fittings: Swing riser assembly fittings which occur in areas subject to traffic by large lawn care equipment shall be the same size as the sprinkler inlet thread. Elbows shall be Schedule 40 PVC; threaded nipples shall be Schedule 80 PVC. All other swing riser fittings may be flexible swing joints using flexible pipe and spiral barb fittings.

Electric Remote Control Valves: Electric remote control valves shall be all brass or plastic construction, with a throttling stem and a manual vent. The solenoid shall be encapsulated 24 volt.

Manual Drain Valves: Manual drain valves shall be bronze construction, angle pattern. The valve seat shall be rubber and shall be connected to the stem. The valve shall have a cross handle. Ball check drains not permitted.

Furnish 2 valve keys, 3-feet long with tee handles and key end to fit valves.

Automatic Drain Valves: Designed to open for drainage when line pressure drops below 3 psi.

Gate Valves: Gate valves shall be all brass construction; wheel handle, screwed ends, line size, 150-pound rated, American-made.

Backflow Preventer: Manufacturer's standard, to suit sprinkler system. The device shall be selected to comply with all local codes. The device shall be approved by the Contracting Officer prior to being installed. A backflow prevention device shall be installed at all points of connection between the potable water system and the landscape irrigation system.

Sprinkler Heads: Manufacturer's standard unit designed to provide uniform coverage over entire area of spray shown on drawings at available water pressure, as follows:

Pop-up Spray Sprinklers: Shall be constructed of heavy-duty plastic and have a wiper seal, an under-nozzle strainer, a stainless-steel retract spring and a machined brass nozzle. The nozzle shall have an adjusting screw.

Minimum Pop-up Height: - 12 inches for groundcover and shrub areas; 4" for lawn areas; 1/2-inch FPT inlet. Precipitation rates of full-circle and part-circle sprinklers shall be compatible when

valved together.

Irrigation Controller: Irrigation controller(s) shall be electronic and shall electrically start the irrigation cycle and automatically time the individual stations. The controllers shall have 117V AC input and 26V AC 60-cycle output; a minimum 16 station capacity or a minimum total of 16 stations; a 14-day programming capability; a 0-60 minute station timing; an automatic rapid advance shall provide for continuous watering without time lapse between omitted stations. Reset circuit breakers shall protect the controller from excessive current draw or voltage. The controller cabinet shall have a key lock feature.

Valve Actuation Wire: Wire shall be No. 14 UF, UL approved, 600-volt rated; RED for control, WHITE for common.

Wire Splices: Wire splicing shall be done with Pen-tite type available from Spears, Rain Bird or Toro.

Valve Access Boxes: Valve access boxes shall be constructed of high-strength, impact-resistant thermoplastic material. Valve box lid shall be of the locking type. All valve access boxes shall be rectangular shape.

PART 3 - EXECUTION

SYSTEM DESIGN:

Design Procedures: Verify pressure and make plan adjustments as needed based on available water pressure to assure a workable system.

Location of Heads: Design location is approximate. Make minor adjustments as necessary to avoid plantings and other obstructions.

Minimum Water Coverage:

The irrigation system shall be capable of providing water coverage equivalent to 1-inch of rain per week.

Layout may be modified, if necessary to obtain coverage, to suit manufacturers standard heads. Do not decrease number of heads indicated unless otherwise acceptable to Contracting Officer.

Install equipment in compliance with all applicable local and state codes.

TRENCHING AND BACKFILLING:

General: Excavate straight and true with bottom uniformly sloped to low points.

Trench Depth: Excavate trenches to a depth of 3" below invert of pipe, unless otherwise indicated.

Minimum Cover: Provide following minimum cover over top of installed piping:

PVC piping. Mainline pipe 24", Circuit piping 12".

Backfill: Backfill with clean materials from excavation. Remove organic material as well as rocks and debris larger than 1" in diameter. Place acceptable backfill materials in 6" lifts, compacting each lift.

INSTALLATION:

General: Unless otherwise indicated, comply with requirements of Uniform Plumbing Code.

Connection to Main: Connect to existing piping in location indicated.

Install new tee, valve, and union.

Maintain uninterrupted water service to building during normal working hours. Arrange for temporary water shut-off with Contracting Officer.

Backflow Preventer: Provide union on downstream side. Install as per manufacturer's recommendation. Size shall be same size as inlet and outlet pipe.

Circuit Valves: Install in valve box, arranged for easy adjustment and removal.

Provide union on downstream side.

Adjust electric remote control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.

Electric Remote Control Valve: Install only one valve per valve box. Valve handle-top at 8 inches below finish grade. Use PVC 45-degree elbows down to lateral line depth. Make wire splice completely waterproof and wrap each wire 18 times around 1/2-inch pipe and leave within valve access box. Use only threaded connections between the main-line pipe and the valve inlet.

Manual Drain Valves: Install manual drain valves at locations to facilitate the complete drainage of the entire irrigation system for winterization. Install handle within a 2-inch PVC sleeve with a locking-type valve marker. Place a 5-cubic-foot gravel sump under each manual drain valve to facilitate drainage.

Valve Actuation Wire: Install under the main-line pipe at all possible locations. Bundle and tape at 50-foot intervals. Install within pipe sleeves and at all locations where pipe is sleeved. Install within a PVC pipe sleeve where unable to place under system pipe.

Valve Access Boxes: Place an 18-inch long cedar 2 x 4 board under each long side of the valve box to stabilize. Bring lid to finish grade. Firmly tamp backfill to prevent settling. Place 2 cubic feet of gravel within each valve box, under the contained valve.

Irrigation Controller: Electrical service to the controller shall be installed within conduit. Controller shall

be wall mounted in the mechanical room as shown on plans and located 5' above finished floor.

The Irrigation Contractor shall coordinate with the General Contractor as to the locations of electrical power supply for controller and connect as necessary per applicable codes.

Piping: Lay pipe on solid subbase, uniformly sloped without humps or depressions.

For circuit piping, slope to drain valve at least 1/2" in 10' of run.

Install PVC pipe in dry weather when temperature is above 40°F (4°C) in strict accordance with manufacturer's instructions.

Allow joints to cure at least 24 hours at temperature above 40°F (4°C) before testing, unless otherwise recommended by manufacturer.

Sprinkler Heads: Flush circuit lines with full head of water prior to installing heads.

Install groundcover and shrub heads at heights and locations indicated. Install lawnheads 6-inches from walks, retaining walls and mowing strips and 12-inches from building foundations.

Firmly tamp backfill around sprinkler riser to prevent settling.

TESTING:

General: Notify Contracting Officer in writing when testing will be conducted. Conduct tests in present of Contracting Officer.

Operational Testing: After the hydrostatic test, sprinkler heads shall be installed and the system completed and tested to demonstrate functional efficiency. The Contractor shall balance and adjust all components to perform as designed.

Demonstrate to Contracting Officer that system meets coverage requirements and that automatic controls function properly.

Coverage requirements are based on operation of one circuit at a time.

Clean-up: The Contractor shall remove all rocks, excess dirt and debris, and equipment from the site at the completion of the Work.

Extra Materials: The Contractor shall furnish to the Contracting Officer at project completion two of each key necessary to open and/or operate all pieces of irrigation equipment.

ACCEPTANCE, GUARANTEE

Acceptance: At the conclusion of irrigation installation, an inspection shall be made by the Landscape Architect. The purpose of this inspection shall be for the acceptance of the contract work. If there are any

deficiencies, the Contractor will be notified and the work subject to re-inspection before final acceptance.

Guarantee: Materials and workmanship shall be guaranteed for one year.

END OF SECTION 02810

SECTION 02831 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

Polyvinyl chloride (PVC) coated steel chain link fabric.

Galvanized-steel framework.

Swing Gates

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

Division 2 Section "Earthwork" for filling and grading work.

Division 3 Section "Cast-in-Place Concrete" for concrete for post footings.

SUBMITTALS

General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

Product data in the form of manufacturer's technical data, specifications, and installation instructions for fence and gate posts, fabric, gates, and accessories.

Shop drawings showing location of fence, gates, each post, and details of post installation, extension arms, gate swing, hardware, and accessories.

Samples for verification of PVC color in form of 6-inch lengths of actual fabric wire to be used in color selected.

QUALITY ASSURANCE

Installer Qualifications: Engage an experienced Installer who has at least three years' experience and has completed at least five chain link fence projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.

Single-Source Responsibility: Obtain chain link fences and gates, including accessories, fittings, and fastenings, from a single source.

PROJECT CONDITIONS

Field Measurements: Verify layout information for fences and gates shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

FABRIC

Selvage: Knuckled at one selvage and twisted at the other for 2-inch and 2-1/8-inch mesh sizes and heights above 60 inches. Knuckle to be on bottom edge.

Steel Chain-Link Fence Fabric: Fabricated in one-piece widths for fencing 12 feet and less in height to comply with Chain Link Fence Manufacturers Institute (CLFMI) "Product Manual" and with requirements indicated below:

Mesh and Wire Size: 2-inch mesh, 0.148-inch diameter (9 gage).

Coating: ASTM F 668, Class 2b, PVC.

PVC Coating Color: Black complying with ASTM F 934.

FRAMING

Round member sizes are given in actual outside diameter (OD) to the nearest thousandth of inches. Round fence posts and rails are often referred to in ASTM standard specifications by nominal pipe sizes (NPS) or the equivalent trade sizes in inches. The following indicates these equivalents all measured in inches:

<u>Actual OD</u>	<u>NPS Size</u>	<u>Trade Size</u>
1.315	1	1-3/8
1.660	1-1/4	1-5/8
1.900	1-1/2	2
2.375	2	2-1/2
2.875	2-1/2	3
3.500	3	3-1/2
4.000	3-1/2	4
6.625	6	6-5/8
8.625	8	8-5/8

Type I Round Posts: Standard weight (schedule 40) galvanized-steel pipe conforming to ASTM F 1083, according to heavy industrial requirements of ASTM F 669, Group IA, with minimum yield strength of 25,000 psi, not less than 1.8 oz. of zinc per sq. ft. Type A coating inside and outside according to ASTM F 1234, as determined by ASTM A 90, and weights per foot as follows:

<u>Actual OD</u>	<u>WeightNPS (lb/ft)</u>	<u>Size</u>
1.315	1.68	1
1.660	2.27	1-1/4
1.900	2.72	1-1/2
2.375	3.65	2
2.875	5.79	2-1/2
3.500	7.58	3
4.000	9.11	3-1/2
6.625	8.97	6
8.625	28.55	8

Top Rail: Manufacturer's longest lengths (17 to 21 feet) with swaged-end or expansion-type coupling, approximately 6 inches long for joining. Provide rail ends or other means for attaching top rail securely to each gate corner, pull, and end post.

Round Steel: 1.660-inch OD Type I steel pipe.

Steel posts for fabric heights up to 6 feet:

Round Line or Intermediate Posts: 1.90-inch OD Type I steel pipe.

Round End, Corner, and Pull Posts: 2.375-inch OD Type I steel pipe.

Steel posts for fabric heights over 6 feet:

Round Line or Intermediate Posts: 2.375-inch OD Type I steel pipe.

Round End, Corner, and Pull Posts: 2.875-inch OD Type I steel pipe.

Swing Gate Posts: Furnish posts to support single gate leaf, or one leaf of a double-gate installation, according to ASTM F 900, sized as follows for steel and aluminum pipe posts:

Steel posts for fabric height of 6 feet or less and gate leaf width:

Up to and Including 4 Feet: 2.375-inch OD pipe weighing at least 3.11 lb per ft.

Over 4 to 10 Feet: 2.875-inch OD pipe weighing at least 4.64 lb per ft.

Over 10 to 18 Feet: 4.000-inch OD pipe weighing at least 8.65 lb per ft.

Steel posts for fabric height over 6 feet and gate leaf width:

Up to and Including 6 Feet: 2.875-inch OD pipe weighing at least 4.64 lb per ft.

Over 6 to 12 Feet: 4.000-inch OD pipe weighing at least 8.65 lb per ft.

Over 12 to 18 Feet: 6.625-inch OD pipe weighing at least 10.02 lb per ft.

Over 18 to 24 Feet: 8.625 OD pipe weighing at least 27.12 lb per ft.

FITTINGS AND ACCESSORIES

Material: Comply with ASTM F 626. Mill-finished aluminum or galvanized iron or steel to suit manufacturer's standards.

Steel and Iron: Unless specified otherwise, hot-dip galvanize pressed steel or cast-iron fence fittings and accessories with at least 1.2 oz. zinc per sq. ft. as determined by ASTM A 90.

Aluminum: Die cast conforming to ASTM B 26, aluminum-alloy 360 or sand cast conforming to ASTM B 85, aluminum-alloy 365, ZG61A, or Tenzalloy.

Supplemental Color Coating: In addition to above metallic coatings, provide a 10-mil minimum polyvinyl chloride (PVC) plastic resin finish applied to exterior surfaces and, except inside cap shapes, to exposed interior surfaces. Color to match chain link fabric.

Post and Line Caps: Provide weathertight closure cap for each post. Provide line post caps with loop to receive tension wire or top rail.

Post Brace Assembly: Manufacturer's standard adjustable brace. Use material specified below for brace, and truss to line posts with 3/8-inch-diameter rod and adjustable tightener. Provide manufacturer's standard galvanized-steel, cast-iron or cast-aluminum cap for each end.

Round Steel: 1.660-inch OD Type I or II steel pipe.

Tension or Stretcher Bars: Hot-dip galvanized steel with a minimum length 2 inches less than the full height of fabric, a minimum cross section of 3/16 inch by 3/4 inch, and a minimum of 1.2 oz. of zinc coating per sq. ft. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into the post.

Tension and Brace Bands: 3/4-inch-wide minimum hot-dip galvanized steel with a minimum of 1.2 oz. of zinc coating per sq. ft.

Tension Bands: 0.074 inch thick (14 gage) minimum.

Brace Bands: 0.105 inch thick (12 gage) minimum.

Tension Wire: 9 gage metallic-coated steel marcelled tension wire conforming to ASTM A 824 with finish to match fabric.

Coating Type II zinc in the following class as determined by ASTM A 90.

Class 2, with a minimum coating weight of 1.20 oz. per sq. ft. of uncoated wire surface.

Tie Wires: 0.106-inch-diameter (12-gage) galvanized steel with a minimum of 0.80 oz. per sq. ft. of zinc coating according to ASTM A 641, Class 3 or 0.148-inch-diameter (9-gage) aluminum wire alloy 1350-

H19 or equal, to match fabric wire.

BARBED WIRE

Barbed Wire Supporting Arms: Manufacturer's standard barbed wire supporting arms conforming to ASTM F 626, metal and finish to match fence framework, with provision for anchorage to posts and attaching three rows of barbed wire to each arm. Supporting arms may be either attached to posts or integral with post top weather cap and must be capable of withstanding 250-lb downward pull at outermost end. Provide following type:

Single 45-degree arm for three strands of barbed wire, one for each post.

Steel Barbed Wire: Two-strand, 0.099-inch-diameter (12-1/2-gage) steel wire with 0.080-inch-diameter (14-gage), four-point barbs spaced not more than 5 inches o.c.; metallic-coated finish to match fabric.

Galvanized Finish: Comply with ASTM A 121, chain link fence grade with Class 3 coating with not less than 0.8 oz. of zinc per sq. ft. as determined by ASTM A 90.

CONCRETE

Concrete: Refer to Specification Section 02520 and Section 03300.

GATES

Swing Gates: Comply with ASTM F 900.

Steel: Gates up to 8 feet wide:

Up to 6 Feet High: Fabricate perimeter frames of 1.660-inch minimum OD Type I or II steel pipe or 1-1/2-inch-square galvanized-steel tubing weighing 1.84 lb per sq. ft.

Over 6 Feet High: Fabricate perimeter frames of 1.90-inch minimum OD Type I or II steel pipe or 2-inch-square galvanized-steel tubing weighing 2.52 lb per sq. ft.

Gate Hardware: Provide galvanized hardware and accessories for each gate according to the following:

Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180-degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6-foot nominal height.

Latch: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as an integral part of latch.

Keeper: Provide a keeper for vehicle gates that automatically engages gate leaf and holds it in the open position until manually released.

Gate Stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage a center drop rod or plunger bar. Include a locking device and padlock eyes as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.

PART 3 - EXECUTION

INSTALLATION

General: Install fence to comply with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted.

Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.

If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.

Unless otherwise indicated, excavate hole depths approximately 3 inches lower than post bottom, with bottom of concrete set not less than 42 inches below finish grade surface.

Setting Posts: Center and align posts in holes 3 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated.

Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.

Top Rails: Run rail continuously through line post caps, bending to radius for curved runs and at other posts terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.

Brace Assemblies: Install braces at end and gate posts and at both sides of corner and pull posts. Locate horizontal braces at mid-height of fabric on fences with top rail and at two thirds fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter (11-gage) hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c.

Fabric: Leave approximately 2 inches between finish grade and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains under tension after pulling force is released.

Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not over 15 inches o.c.

Tie Wires: Use wire of proper length to secure fabric firmly to posts and rails. Bend ends of wire to minimize hazard to persons or clothing.

Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to rails and braces 24 inches o.c.

Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts for added security.

Barbed Wire: Pull wire taut and install securely to extension arms and secure to end post or terminal arms according to manufacturer's instructions.

GATE INSTALLATION

Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary. Install gates according to manufacturer's instructions, plumb, level, and secure.

END OF SECTION 02831

SECTION 02900 - LANDSCAPE WORK

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and General provisions of Contract, including General and Division 1 Specification Sections, apply to this Section.

SUMMARY

This Section includes provisions for the following items:

- Trees.
- Shrubs.
- Mulch.
- Fertilizer.
- Watering.
- Wrapping.
- Staking.
- Replacement.
- Ground Cover.
- Lawns.
- Soil amendments.
- Initial maintenance of landscape materials.
- Edging

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

Excavation, filling, and rough grading required to establish elevations shown on drawings if specified in Division 2 Section, "Earthwork."

Clearing, grubbing and topsoil removal is specified in Division 2 Section, "Site Clearing."

QUALITY ASSURANCE

Subcontract landscape work to a single firm specializing in landscape work.

Source Quality Control:

General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.

Do not make substitutions. If specified landscape materials is not obtainable, submit proof of non-availability to Contracting Officer, together with proposal for use of equivalent material.

Analysis of Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

Trees, Shrubs and Groundcover: Provide trees, shrubs, and groundcover of quantity, size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock." Provide healthy, vigorous, freshly dug stock, grown in recognized nursery in accordance with good horticulture practice and free of disease, insects, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.

Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name.

Label at least one groundcover plant of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.

Inspection: The Contracting Officer may inspect trees, shrubs, and groundcover either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size and quality. Contracting Officer retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees, shrubs or groundcover immediately from project site.

SUBMITTALS

General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections:

Plant and Material Certifications:

Certificates of Inspection as required by governmental authorities.

Manufacturer's or Vendor's certified analysis for soil amendments and fertilizer materials.

Label Data substantiating that trees, shrubs and planting materials comply with specified requirements.

Seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentages by weight, and percentages of purity, germination, and weed seed for each grass seed species.

Planting Schedule: Proposed planting schedule, indicating dates for each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

Maintenance Instructions: Typewritten instructions recommending procedures to be established by Government for maintenance of landscape work for one full year. Submit prior to expiration of required maintenance period(s).

DELIVERY, STORAGE AND HANDLING:

Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

Trees and Shrubs: Provide freshly dug trees and shrubs. Do not prune prior to delivery unless otherwise approved by Contracting Officer. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.

Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.

Do not remove container-grown stock from containers until planting time.

JOB CONDITIONS

Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Contracting Officer before planting.

SEQUENCING AND SCHEDULING

Planting Time: Proceed with, and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.

Plant or install materials during normal planting seasons for each type of plant material required.

Coordinate with Lawns: Plant trees, shrubs and groundcover after final grades are established and prior to planting of lawns, unless otherwise acceptable to Contracting Officer. If planting of trees, shrubs and groundcover occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

PART 2 - PRODUCTS

TOPSOIL

Topsoil for the landscape work is not available at the site and must be furnished as specified.

Provide new topsoil that is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth.

Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

SOIL AMENDMENTS

Peat: Shall be free from lumps, roots, woody material, and stones or other foreign matter, and shall contain no less than ninety percent (90%) organic matter by weight on an oven-dry basis. Peat moss shall be free of mineral matter harmful to plant life, water-absorbing capacity 1,100 to 2,000 percent; moisture content thirty percent (30%) natural; acid reaction 4 to 5 pH.

Commercial Fertilizer: Commercial fertilizer shall be uniform in composition, free-flowing, and conforming to the applicable state and federal fertilizer laws. Deliver to site in unopened, original containers, each bearing the manufacturer's guaranteed analysis and in conformity with state fertilizer laws. Fertilizer shall contain the following minimum percentage of plant food by weight:

12% available Nitrogen
12% available Phosphoric Acid
12% available Potash

Application of Fertilizer: Fertilizer shall be distributed uniformly at a rate of 600 pounds per acre over the areas indicated to be seeded and shall be incorporated into the soil to a depth of at least three (3) to four (4) inches by disking, harrowing, or other approved methods. The incorporation of fertilizer may be a part of the tillage operation hereinbefore specified. Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will not be acceptable. Fertilizer shall be incorporated into the soil a minimum of ten (10) days before seed is planted.

PLANT MATERIALS

Quality: Provide trees, shrubs, and other plants of size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock."

Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.

Provide balled and burlapped (B&B) deciduous trees.

Deciduous Shrubs: Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.

Coniferous and Broadleafed Evergreens: Provide evergreens of sizes shown or listed. Dimensions indicated minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well balanced form complying with requirements for other size relationships to the primary dimension shown. Provide balled and burlapped (B&B) deciduous trees.

GRASS MATERIAL

Grass Seed: Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America. Provide seed Type A (K-31 tall Fescue with a minimum of 80% P.L.S. and maximum 3% weed seed), and seed Type "B" (Buffalo "Bison" seed).

Grass Sod: Provide clean, strongly rooted, uniformly sized strips of 2 year old sod of Buffalo Hybrid. Sod shall be machine-stripped not more than 24 hours prior to laying. Sod shall be free of weeds and undesirable native grasses.

GROUND COVER

Provide plants established and well rooted in removable containers or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the pot size shown or listed.

MISCELLANEOUS LANDSCAPE MATERIALS

Mulch: Organic mulch free from deleterious materials and suitable for top dressing of trees and shrub. Mulch shall be medium size, Dried Redwood Chips. Spread evenly to a thickness of three (3) inches and thoroughly water immediately after placing.

Lawn Seeding Mulch: Provide clean, seed-free threshed straw mulch.

Steel Edging: Commercial steel edging of size shown on drawings fabricated in sections with loops pressed from or welded to face of selections at 2'-6" o.c. to receive stakes. Provide tapered steel stakes 16 inches long. Finish edging sections and stakes with manufacturer's standard green-black paint.

Wrapping Material: Wrapping material for tree trunks shall be two (2) thicknesses of crinkled paper, cemented together with bituminous material. Wrapping material shall be strips three (3) to five (5) inches wide, having qualities to resist insect infestation.

Material for Guying and Staking:

Wire: Shall be pliable, zinc coated iron of No.1 12 gage, twisted in a double strand allowing for

tightening or loosening the guy-wire during the guarantee period.

Protection of Trees from Wire: Hose to encase wire used for fastening trees to stakes shall be two-ply reinforced rubber garden hose, having an inside diameter of not less than one-half ($\frac{1}{2}$) inch. (minimum length 18 inches.)

Stakes: For supporting trees shall be straight, sound, not less than two (2) inches if square, or two and one-half ($2\frac{1}{2}$) inches in diameter if round, and eight (8) feet long.

PART 3 - EXECUTION

PREPARATION - GENERAL

Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Contracting Officer's acceptance before start of planting work. Make minor adjustments as may be required.

PREPARATION OF PLANTING SOIL

Before mixing, clean topsoil of roots, plants, clods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.

Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days. Fertilize topsoil for planting trees with a commercial fertilizer, applied and mixed at the rate of not less than 0.25 pounds per cubic foot of soil mix.

For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at site.

For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.

PREPARATION FOR PLANTING LAWNS

Loosen subgrade of lawn areas to a minimum depth of 4 inches. Remove stones measuring over 1-1/2 inches in any dimension. Remove sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.

Spread topsoil to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement. Add specified soil amendments and mix thoroughly into upper 4 inches of topsoil. Minimum topsoil depth of 6" is to be provided.

Place approximately $\frac{1}{2}$ of total amount of topsoil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil. Add specified soil amendments

and mix thoroughly into upper 4 inches of topsoil.

Preparation of Unchanged Grades: Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows: Till to a depth of not less than 6 inches. Apply soil amendments and initial fertilizers as specified. Remove high areas and fill in depressions. Till soil to a homogeneous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter.

Fine grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll, rake, and drag lawn areas, remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.

Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

Restore lawn areas to specified condition, if eroded or otherwise disturbed, after fine grading and prior to planting.

PREPARATION OF PLANTING BEDS

Loosen subgrade of planting bed areas to a minimum depth of 6 inches using a cult-mulcher or similar equipment. Remove stones measuring over 1-1/2 inches in any dimension. Remove sticks, stones, rubbish, and other extraneous matter.

Spread planting soil mixture to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement. Place approximately ½ of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer, then place remainder of the planting soil.

EXCAVATION FOR TREES AND SHRUBS

Excavate pits, beds and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

For balled and burlapped (B&B) trees and shrubs, make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill:

Allow for 3-inch thick setting layer of planting soil mixture.

For container grown stock excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.

Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.

Fill excavations for trees and shrubs with water and allow water to percolate out prior to planting.

PLANTING TREES AND SHRUBS

Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove wires, ropes, and other tying materials that could cause girdling from around the plant stem. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around bases and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill. Do not plant if ball is cracked or broken before or during planting process.

Set container grown stock, as specified, for balled burlapped stock, except containers shall be cut open and the plants carefully removed so that the earth around the roots of the plant remains unbroken.

Dish top of backfill to allow for mulching.

Mulch pits, trenches, and planted areas. Provide not less than following thickness of mulch, and work into top of backfill and finish level with adjacent finish grades.

Provide 3 inch thickness of mulch.

Prune, thin out, and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Contracting Officer, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character.

Remove and replace excessively pruned or misformed stock resulting from improper pruning.

Wrap tree trunks. Start at ground and over trunk to height of first branches and securely attach. Inspect tree trunks for injury, improper pruning and insect infestation and take corrective measures before wrapping.

Guy and stake trees immediately after planting as indicated. All trees shall be staked with two stakes placed on opposite sides of the tree, outside of the ball and planting soil.

SEEDING NEW LAWNS

Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

Sow seed using a spreader or seeding machine. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.

Sow not less than 10 lbs. per 1000 square feet of Type "A" seed (fescue) as seasonal conditions permit. Sow not less than 2-3 lbs. PLS per 1000 square feet of Type "B" seed (Buffalo) in the month of May following the initial fescue seeding. Overseeding shall be by drilling.

Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with a fine spray.

Protect seeded areas against erosion by spreading specified lawn mulch after completion of seeding operations. Spread uniformly to form a continuous blanket not less than 1-1/2 inches loose measurement over seeded areas.

WATER NEWLY PLANTED LAWN AREAS and keep moist until new grass is established.

SODDING LAWNS AREAS

Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.

Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade and sod. Tamp and roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.

Water sod thoroughly with a fine spray immediately after planting.

PLANTING GROUND COVER

Space ground cover plants as indicated in plant list.

Dig holes large enough to allow for spreading of roots and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.

Mulch areas between ground cover plants; place not less than 3 inches thick.

MAINTENANCE

Begin maintenance immediately after planting.

Maintain trees, shrubs, and other plants until final acceptance by Contracting Officer, but in no case, less than the following period:

60 days after substantial completion of planting.

Maintain trees, shrubs, and other plants by pruning, cultivating and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and diseases. Plants shall be inspected at least one (1) time per week by the Contractor during the maintenance period and needed maintenance performed promptly.

Maintain lawns for not less than the period stated below, and longer as required to establish an acceptable

lawn.

Seeded and sodded lawns, not less than 60 days after substantial completion.

If seeded in fall and not given full 60 days of maintenance, or if not considered acceptable at that time, continue maintenance the following spring until acceptable lawn is established.

Maintain lawns by watering, fertilizing, weeding, mowing, trimming and other operations such as rolling, regrading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

CLEANUP AND PROTECTION

During landscape work, keep pavements clean and work area in an orderly condition.

Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

ACCEPTANCE, WARRANTY AND REPLACEMENT

Acceptance: When landscape work is completed, including maintenance, Contracting Officer will, upon request, make an inspection to determine acceptability. If there are any deficiencies in the work or maintenance, the Contractor will be notified and the work subject to re-inspection before final acceptance.

Acceptable standard for seeded areas shall be when scattered bare spots, not greater than one (1) square foot, do not exceed three percent (3%) of the lawn areas.

Warranty: Warranty trees, shrubs, and groundcover for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Landscape Installer's control. During the warranty period, the Contractor shall inspect the plant materials twice a month (or more as necessary), for improper watering and other maintenance conditions that might be injurious to the plant material. Should such a condition exist, Contractor shall notify the Contracting Officer in writing. Otherwise, plants found to be dead or damaged will be assumed to be in that condition due to improper planting or unhealthy plants, and shall be replaced by the Contractor at no expense to the Government.

All seeded areas not meeting the accepted standard as noted will be reseeded as soon as seasonal conditions permit. Reseeding shall be done at no extra cost to the Government.

All sodded areas not meeting the accepted standard as noted will be resodded as soon as seasonal conditions permit. Resodding shall be done at no extra cost to the Government.

Replacement and Reseeding: At the end of the warranty period, the Contracting Officer will make an inspection to determine the project condition. As determined by the Contracting Officer, dead and deficient material will be noted and as soon as seasonal conditions permit, shall be removed from the site

and replaced with plants of the same species and sizes as originally specified. Such replacements shall be made in same manner as specified for the original plantings and at no extra cost to the Government. The Warranty on plants shall be limited to one (1) replacement.

Reseeding shall be with the seed specified hereinbefore for seeding and shall be sown at the rate of eight (8) pounds per thousand square feet in a manner that will cause a minimum of disturbance to the existing stand of grass and at an angle of not less than 15 degrees from the direction of the rows of prior seeding. Damage to existing plant materials, seeding, sidewalk, etc., during replacement or reseeding shall be repaired without cost to the Government.

Resodding shall be with the sod specified hereinbefore. Damage to existing plant materials, sodding, sidewalk, etc., during replacement or resodding shall be repaired without cost to the Government.

END OF SECTION 02900

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

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

Division 2 Section "Exterior Portland Cement Concrete" for concrete paving and walks.

Division 2 Section "Exterior Portland Cement Concrete Pavement for Airfield Construction" for exterior apron and tow-way paving.

Division 2 Section "Auger Cast Piles" for auger cast piles.

Division 4 Section "Unit Masonry" for grout.

Division 9 Section "Reflective Chemically Resistant Urethane Floor Coating" for coating on Hangar Bay slab.

SUBMITTALS

General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, and others if requested by Architect.

Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.

Samples of materials as requested by Contracting Officer, including names, sources, and descriptions.

Laboratory test reports for concrete materials and mix design test.

Material certificates in lieu of material laboratory test reports when permitted by Contracting Officer.

Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements.

QUALITY ASSURANCE

Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."

ACI 318, "Building Code Requirements for Reinforced Concrete."

Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."

Concrete Testing Service: Employ at Contractor's expense a testing agency acceptable to Contracting Officer to perform material evaluation tests and to design concrete mixes.

Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Contractor's expense.

PROJECT CONDITIONS

Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing, maintain cover for time period as necessary.

Protect adjacent finish materials against spatter during concrete placement.

PART 2 - PRODUCTS

FORM MATERIALS

Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints.

Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

Forms for Exposed Columns and Supports: Metal or glass-fiber-reinforced plastic that will produce smooth surfaces without joint indications. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.

Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 g/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

CAST-IN-PLACE CONCRETE

Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.

Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.

REINFORCING MATERIALS

Reinforcing Bars: ASTM A 615, Grade 60, deformed, including supplementary requirements S1. Refer to Structural Drawings.

Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.

For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

CONCRETE MATERIALS

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

Use one brand of cement throughout Project.

Fly Ash: Fly ash will not be permitted in concrete.

Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.

For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.

Aggregates shall be proportioned such that mix design shall contain a minimum of 50% coarse aggregates by gradation requirements set forth in ASTM C 33. Coarse aggregate shall meet No. 67 grading requirements.

Coarse aggregates shall pass the five-cycle magnesium sulphate accelerated soundness test with less than 18% loss.

Coarse aggregates shall have an absorption limit of 4% or less as determined by ASTM C127.

Local aggregates not complying with ASTM C 33 but which have shown by special test or actual

service to produce concrete of adequate strength and durability may be used when acceptable to Architect.

Water: Potable.

Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions. Concrete supplier shall certify that all admixtures, release agents, sealers and curing compounds are compatible with each other.

Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

Products: Subject to compliance with requirements, provide one of the following:

Darex AEA or Daravair, W.R. Grace & Co.
MB-VR, Master Builders, Inc.
Sika AER, Sika Corp.

Water-Reducing Admixture: ASTM C 494, Type A.

Products: Subject to compliance with requirements, provide one of the following:

WRDA Hycol, W.R. Grace & Co.
Pozzolith 344, Master Builders, Inc.
Plastocrete 161, Sika Corp.

High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.

Products: Subject to compliance with requirements, provide one of the following:

WRDA 19 or Daracem, W.R. Grace & Co.
Pozzolith 400, Master Builders, Inc.
Sikament 300 or Sikament 86, Sika Corp.

Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.

Products: Subject to compliance with requirements, provide one of the following:

Pozzolith 500, Master Builders, Inc.

Water-Reducing, Retarding Admixture: ASTM C 494, Type D.

Products: Subject to compliance with requirements, provide one of the following:

Daratard-17, W.R. Grace & Co.
Pozzolith 300, Master Builders, Inc.

Plastocrete 161 MR, Sika Corp.

RELATED MATERIALS

Reglets: Where sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217-inch-thick (26-gage) galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

Waterstops: Provide flat, dumbbell-type or centerbulb-type waterstops at construction joints and other joints as indicated. Size to suit joints.

Vapor Retarder: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:

Polyethylene sheet not less than 8 mils thick.

Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

Waterproof paper.

Polyethylene film.

Polyethylene-coated burlap.

Liquid Membrane-Forming Curing Compound: Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I, Class A or B. Moisture loss not more than 0.55 kg/sq. meter when applied at 200 sq. ft./gal.

Products: Subject to compliance with requirements, provide one of the following:

RX Cure, Conspec Marketing & Mfg. Co.

Kurez Dre, Euclid Chemical Co.

L&M Cure R, L&M Construction Chemicals, Inc.

Underlayment Compound: Free-flowing, self-leveling, pumpable, cement-based compound for applications from 1 inch thick to feathered edges.

Products: Subject to compliance with requirements, provide one of the following:

Conflow, Conspec Marketing & Mfg. Co.

Level-Cure LCB, C-Cure Chemical Co., Inc.

Level-Cure SLU, C-Cure Chemical Co., Inc.

Thoro Underlayment Self-Leveling, Thoro System Products.

Bonding Agent: Polyvinyl acetate or acrylic base.

Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.

Products: Subject to compliance with requirements, provide one of the following:

Spec-Bond 100, Conspec Marketing & Mfg. Co.
Euco Epoxy System #452 or #620, Euclid Chemical Co.
Sikadur 32 Hi-Mod, Sika Corp.
Tyiopoxy, W.R. Grace.

Wear-Resistant Finish: Packaged dry combination of materials consisting of portland cement, silica quartz aggregate, and plasticizing admixture.

Products: Subject to compliance with requirements, provide one of the following.

Conshake 500, Conspec Marketing & Mfg. Co.

Expansion Joint Filler: Refer to Specification Section 07900.

Chemical Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. of fluosilicates per gal.

Products: Subject to compliance with requirements, provide one of the following:

Intraseal, Conspec Marketing & Mfg. Co.
Diamond Hard, Euclid Chemical Co.

PROPORTIONING AND DESIGNING MIXES

Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Contracting Officer for preparing and reporting proposed mix designs.

Use of fly ash will not be permitted.

Submit written reports to Contracting Officer of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Contracting Officer.

Design mixes to provide normal weight concrete with the following properties and as indicated on drawings and schedules:

Exterior Concrete: 4000-psi. Refer to Section 02520.

Interior Concrete: Refer to Structural Drawings and General Structural Notes.

Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

Ramps, slabs, and sloping surfaces: Not more than 4 inches.

Reinforced foundation systems: Not less than 3 inches and not more than 5 inches.

Concrete containing high-range water-reducing admixture (superplasticizer): Not more than 8 inches after adding admixture to site-verified 2-to-3-inch slump concrete.

Other concrete: Not less than 1 inch nor more than 4 inches.

Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in Work.

ADMIXTURES

Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:

Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:

Minimum 4.0 percent, maximum 7.0 percent for 3/4-inch maximum aggregate.

Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent air.

Use admixtures in strict compliance with manufacturer's directions.

CONCRETE MIXING

Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

GENERAL

CAST-IN-PLACE CONCRETE

Coordinate the installation of joint materials, vapor retarder, and other related materials with placement of forms and reinforcing steel.

Reinforcement shall be bundled and tagged with weatherproof tags, indicating location, size and length.

FORMS

General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:

Provide Class A tolerances for concrete surfaces exposed to view.

Provide Class C tolerances for other concrete surfaces.

Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.

Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.

Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.

Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

VAPOR RETARDER INSTALLATION

General: Place vapor retarder sheeting in position with longest dimension parallel with direction of pour.

Lap joints 6 inches and seal with manufacturer's recommended pressure-sensitive tape.

PLACING REINFORCEMENT

General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.

Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations. Repair damages before placing concrete.

Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

Install welded wire fabric in lengths as long as practicable. Overlap adjoining pieces a minimum of 2 wires plus 2" and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

Heating of reinforcement for bending or placement shall not be permitted. Welding or tack-welding of reinforcement shall not be permitted, unless specifically indicated.

JOINTS

Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Architect.

Provide keyways at least 1-1/2 inches deep in construction joints in walls and slabs and between walls and footings. Bulkheads designed and accepted for this purpose may be used for slabs.

Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise.

Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Support and protect exposed waterstops during progress of Work.

Field-fabricate joints in waterstops according to manufacturer's printed instructions.

Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

Contraction (Control) Joints in Interior Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown and as directed. Use saw cuts 1/8 inch wide by one-fourth of slab depth or inserts 1/4 inch wide by one-fourth of slab depth, unless otherwise indicated.

Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate. Cutting shall be completed within 12 hours of placing concrete.

Location of control joints shall be reviewed and approved by Contracting Officer.

Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

Refer to Section 02520 for exterior joints in exterior pavement and walks.

INSTALLING EMBEDDED ITEMS

General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

PREPARING FORM SURFACES

General: Coat contact surfaces of forms with an approved, non-residual, low-VOC, form-coating compound before placing reinforcement.

Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

Coat steel forms with a non-staining, rust-preventative material. Rust-stained steel formwork is not acceptable.

Clean forms of concrete matrix residue, repair and patch as required to return forms to an acceptable surface condition.

CONCRETE PLACEMENT

CAST-IN-PLACE CONCRETE

Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.

Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

Concrete shall not be subjected to a free fall exceeding 4' during any stage of transporting or placing; use tremies or trunks for any distance greater than 4'. Port holes may be used in lieu of above.

Avoid splashing of forms or reinforcing above the general level of the concrete which shall be maintained generally uniform with each pour becoming an integral part of the previous one.

Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.

Use square head mechanical vibrator or agitator for full compaction where practical; spade, settle or slightly shake reinforcing to insure flow of concrete around it.

Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.

Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.

Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

Maintain reinforcing in proper position during concrete placement.

Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect.

FINISHING FORMED SURFACES

Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

MONOLITHIC SLAB FINISHES

Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified.

After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to meet an overall tolerance of F(F) 30 (floor flatness) and F(L) 20 (floor levelness) and to meet a local tolerance of within any 500 square foot area F(F) 15 (floor flatness) and F (L) 10 (floor levelness) when measured in accordance with ASTM E1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.

After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance. Finish surfaces to meet an overall tolerance of F (F) 20 (floor flatness) and F (L) 17 (floor levelness) and to meet a local tolerance within any 500 square foot area of F (F) 16 (floor flatness) and F (L) 10 (floor levelness) when measured in accordance with ASTM E1155. Grind smooth any surface defects that would telegraph through applied floor covering system.

Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.

Non-slip Broom Finish: Apply a non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

Slab Flatness Testing: The Contractor shall employ an independent testing firm to measure the local tolerance in accordance with ASTM E-1155 for areas of no less than 500 square foot selected by the Contracting Officer.

If the above testing is out of tolerance, the Contracting Officer may require additional slab measurements as required to determine extent of defective slabs.

HANGAR BAY & CONCRETE SLAB TREATMENT

Apply liquid membrane forming curing compound per manufacturer's printed instructions, and compatible with reflective chemically resistant methane floor coating. Refer to Specification Section 09911.

EXPOSED CONCRETE SLAB TREATMENT

Where concrete is scheduled to receive no other finish, apply wear-resistant finish, chemical hardener finish and liquid membrane forming curing compound as follows:

Wear-Resistant Finish: Apply a wear-resistant finish to monolithic slab surface indicated.

Apply dry shake materials for the wear-resistant finish at a rate of 100 lb per 100 sq. ft., unless a greater amount is recommended by material manufacturer.

Cast a trial slab approximately 10 feet square to determine actual application rate, and finish, as acceptable to Architect.

Immediately following the first floating operation, uniformly distribute with mechanical spreader approximately two-thirds of the required weight of the dryshake material over the concrete surface, and embed by power floating. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material with overlapping applications to ensure uniform color, and embed by power floating.

After broadcasting and floating, apply a trowel finish as specified.

Chemical-Hardener Finish: Apply proprietary chemical hardeners in accordance with manufacturer's printed instruction.

Liquid Membrane Forming Curing Compound: Apply liquid membrane forming curing compound and cure slab surfaces as recommended by Wear-Resistant and Chemical-Hardener Finish manufacturer.

Sequence and rate of application shall be per manufacturer's instructions.

MISCELLANEOUS CONCRETE ITEMS

Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

CONCRETE CURING AND PROTECTION

General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.

Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.

Provide moisture curing by the following methods:

Keep concrete surface continuously wet by covering with water.

Use continuous water-fog spray.

Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.

Provide moisture-retaining cover curing as follows:

Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:

Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat

surfaces, by applying the appropriate curing method.

Final cure concrete surfaces to receive finish flooring with a moisture-retaining cover, unless otherwise directed.

SHORES AND SUPPORTS

General: Comply with ACI 347 for shoring and reshoring.

Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to support work without excessive stress or deflection.

REMOVING FORMS

General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

All wood forms and supports shall be removed.

REUSING FORMS

Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Contracting Officer.

CONCRETE SURFACE REPAIRS

Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Contracting Officer.

Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.

For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.

Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.

Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.

Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Contracting Officer.

Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

Repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact

dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

Perform structural repairs with prior approval of Contracting Officer for method and procedure, using specified epoxy adhesive and mortar.

Repair methods not specified above may be used, subject to acceptance of Contracting Officer.

QUALITY CONTROL TESTING DURING CONSTRUCTION

General: The Contractor shall employ a testing agency to perform tests and to submit test reports.

Sampling and testing for quality control during concrete placement shall include the following:

Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.

Air Content: ASTM C 173, volumetric method for light weight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.

Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.

Compression Test Specimen: ASTM C 31; one set of three standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.

Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cu. yd. more than the first 25 cu. yd. of each concrete class placed in any one day; one specimen tested at 7 days, one specimen tested at 28 days, and one specimen retained in reserve for later testing if required.

When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

Test results shall be reported in writing to Contracting Officer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of

concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

Additional Tests: The testing agency shall make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for all tests, including additional tests.

END OF SECTION 03300

SECTION 03301 - REINFORCED CONCRETE

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JANUARY 5, 1999
TREES, PLANTS, AND
GROUND COVERS

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
1. American Concrete Institute (ACI):
 - a. 301, Specifications for Structural Concrete for Buildings.
 - b. 305R, Hot Weather Concreting.
 - c. 306R, Cold Weather Concreting.
 - d. 318/318R, Building Code Requirements for Reinforced Concrete.
 - e. 347, Formwork for Concrete.
 2. American Society for Testing and Materials (ASTM):
 - a. A497, Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 - b. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - c. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - d. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - e. C94, Standard Specification for Ready-Mixed Concrete.
 - f. C150, Standard Specification for Portland Cement.

- g. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
 - h. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - i. C494, Standard Specification for Chemical Admixtures for Concrete.
 - j. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
3. Concrete Reinforcing Steel Institute (CRSI):
- a. Manual of Standard Practice, 1990, 25th Edition.
 - b. Recommended Practice for Placing Reinforcing Bars.

1.2 SUBMITTALS

A. Shop Drawings:

- 1. Reinforcing steel in accordance with CRSI 1990 Manual of Standard Practice and ACI SP.
- 2. Curing compound data.
- 3. Complete data on the concrete mix, including aggregate gradations and admixtures, in accordance with ASTM C94.
- 4. Clear floor hardener data.

B. Quality Control Submittals:

- 1. Manufacturer's application instructions for curing compound.
- 2. Ready-mix delivery tickets for each truck in accordance with ASTM C94.

1.3 QUALITY ASSURANCE

- A. Formwork: Unless otherwise specified, follow the recommendations of ACI 347.
- B. Concrete and Reinforcement: Unless otherwise specified, meet the requirements of ACI 301 and 318/318R.
- C. Hot Weather Concreting: Conform to ACI 305R.
- D. Cold Weather Concreting: Conform to ACI 306R.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not place Concrete when the ambient temperature is below 40 degrees F or approaching 40 degrees F and air temperature less than 40 degrees F for the first 7 days, without special protection to keep Concrete above 40 degrees F.
- B. Do not use curing compound where solvents in the curing compounds are prohibited by state or federal air quality laws. Use only water curing methods.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Ready-mixed meeting ASTM C94, Option A.
- B. Portland Cement: ASTM C150, Type I or Type II.
- C. Admixtures:
 - 1. Air-Entraining: ASTM C260.
 - 2. Water-Reducing: ASTM C494, Type A or D.
 - 3. Superplasticizers: ASTM C494, Type F or G.
 - 4. Color Pigments: Inert mineral or metaloxide pigments, either natural or synthetic; resistant to lime and other alkalis.
- D. Mix Design:
 - 1. Minimum Allowable 28 day Compressive Field Strength: 4,000 psi when cured and tested in accordance with ASTM C31 and C39.
 - 2. Coarse Aggregate Size: 1 inch and smaller.
 - 3. Slump Range: 3 to 5 inches.
- 1. 4. Air Entrainment: Between 3 and 6 percent by volume.
- 2. 5. Water Reducers: Use in all concrete.
- E. Mixing: Minimum 70 and maximum 270 revolutions of mixing drum. Nonagitating equipment is not allowed.

2.2 REINFORCING STEEL

- A. Deformed Bars: ASTM A615, Grade 60.

- B. Welded Wire Fabric: ASTM A497.

2.3 ANCILLARY MATERIALS

- A. Expansion Joint Filler: ASTM D994, 1/2-inch thick, or as shown.
- B. Nonshrink Grout:
 - 1. Color: To match concrete.
 - 3. Manufacturers and Products:
 - a. Master Builder Co., Cleveland, OH; Master Flow 928.
 - b. Euclid Chemical Co., Cleveland, OH; Hi-flow Grout.
- C. Curing Compound:
 - 1. Material: Water based in accordance with ASTM C309 Type 1, with additional requirement that the moisture loss not exceed 0.35 kilograms per meter squared per 72 hours.
 - 2. Manufacturers and Products:
 - a. Master Builders Co.; Masterkure 200 W.
 - b. Euclid Chemical Co.; Euco Super Diamond Clear VOX.
- D. Clear Floor Hardener (Surface-Applied): Colorless, aqueous solution of zinc and magnesium fluosilicate with a minimum 2 pounds of crystals per gallon.
 - 1. Manufacturers:
 - a. Master Builders, Co., Cleveland, OH.
 - b. A. C. Horn, Inc., North Bergen, NJ.
 - c. Sonneborn, Minneapolis, MN.

PART 3 EXECUTION

3.1 FORMWORK

- A. Form Materials:
 - 1. Use hard plastic finished plywood for exposed areas, and new shiplap or plywood

for unexposed areas.

2. Earth cuts may be used for forming footings.

B. Form Ties:

1. Fixed conical or spherical type inserts that remain in contact with forming material and allow for dry packing of form tie holes.
2. Ties shall withstand pressures and limit deflection of forms to acceptable limits.
3. Wire ties are not acceptable.

C. Construction:

1. In accordance with ACI 347.
2. Make joints tight to prevent escape of mortar and to avoid formation of fins.
3. Brace as required to prevent distortion during concrete placement.
4. On exposed surfaces locate form ties in uniform pattern or as shown.
5. Construct so ties remain embedded in the wall with no metal within 1-inch of concrete surface when forms, inserts, and tie ends are removed.

D. Form Removal:

1. Remove after concrete has attained 28 day strength, or approval is obtained in writing from CONTRACTING OFFICER.
2. Remove forms with care to prevent scarring and damaging the surface.

3.2 PLACING REINFORCING STEEL

- A. Unless otherwise specified, place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars.

B. Splices and Laps:

1. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.
 2. Horizontal wall bars are considered top bars.
 3. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.
4. 3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301.
- B. Prior to placing concrete, remove water from excavation and debris and foreign material from forms. Check reinforcing steel for proper placement and correct discrepancies.
- C. Before depositing new concrete on old concrete, clean surface using sandblast or bushhammer or other mechanical means to obtain a 1/4-inch rough profile, and pour a cement-sand grout to minimum depth of 1/2-inch over the surface. Proportion 1 part cement to 2.5 parts sand by weight.
- D. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 2 feet deep. Place within 1-1/2 hours after adding cement to mix.
- E. 8 feet maximum vertical drop to final placement, when not guided with chutes or other devices to prevent segregation due to impact with reinforcing.

3.4 COMPACTION

- A. Vibrate concrete as follows:
 - 1. Apply approved vibrator at points spaced not farther apart than vibrator's effective radius.
 - 2. Apply close enough to forms to vibrate surface effectively but not damage form surfaces.
 - 3. Vibrate until concrete becomes uniformly plastic.
 - 4. Vibrator must penetrate fresh placed concrete and into previous layer of fresh concrete below.

3.5 CONSTRUCTION JOINTS

- A. Locate as shown or as approved.
- B. Maximum Spacing Between Construction Joints in Wells: 40 feet.

3.6 CONTROL JOINTS IN SLABS

- A. Locate as shown or as approved.
- B. Maximum Spacing Between Control Joints in Reinforced Floor Slabs: 25 feet.

3.7 FINISHING

- A. Floor Slabs and Tops of Walls:

1. Screed surfaces to true level planes.
 2. After initial water has been absorbed, float with wood float and trowel with steel trowel to smooth finish free from trowel marks.
 3. Do not absorb wet spots with neat cement.
- B. Unexposed Slab Surfaces: Screed to true surface, bull float with wood float, and wood trowel to seal surface.
- C. Tolerances: Floors shall not vary from level or true plane more than 1/4-inch in 10 feet when measured with a straightedge.
- D. Exterior Slabs and Sidewalks:
1. Bull float with wood float, wood trowel, and lightly trowel with steel trowel.
 2. Finish with broom to obtain nonskid surface.
 3. Finish exposed edges with steel edging tool.
 4. Mark walks transversely at 5-foot intervals with jointing tool.

3.8 FINISHING AND PATCHING FORMED SURFACES

- A. Cut out honeycombed and *defective* areas.
- B. Cut edges perpendicular to surface at least 1-inch deep. Do not feather edges. Soak area with water for 24 hours.
- C. Patch with shotcrete or low pressure mortar.
- D. Finish surfaces to match adjacent concrete.
- E. Keep patches damp for minimum 7 days or spray with curing compound to minimize shrinking.
- F. Fill form tie holes with Nonshrink Grout.

3.9 PROTECTION AND CURING

- A. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.
- C. Keep concrete slabs continuously wet for a 7 day period. Intermittent wetting is not acceptable.

- D. Use curing compound only where approved by CONTRACTING OFFICER. Cure formed surfaces with curing compound applied in accordance with manufacturer's directions as soon as forms are removed and finishing is completed.
- E. Remove and replace concrete damaged by freezing.

3.10 CLEAR HARDENER APPLICATION

- A. Before application, water cure floors to receive hardener, wait for minimum 28 days, keep clean, unpainted, free from membrane curing compounds, and perfectly dry with all work above them completed.
- B. Apply hardener evenly, using three coats, allowing 24 hours between coats:
 - 1. First coat 1/3 strength, second coat 1/2 strength, and third coat 2/3 strength, mix with water.
 - 2. Apply each coat so as to remain wet on surfaces for 15 minutes.
 - 3. Apply approved hardeners in accordance with manufacturer's instructions.
 - 4. After final coat is completed and dry, remove surplus hardener from surface by scrubbing and mopping with water.

3.11 FIELD TESTS

- A. Evaluation of Concrete Field Strength: In accordance with ACI 318/318R.

END OF SECTION

SECTION 03600 - GROUT
PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society for Testing and Materials (ASTM):
 - a. C230, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
 - b. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
2. Corps of Engineers (COE):
 - a. CRD-C611, Flow of Grout for Preplaced Aggregate Concrete.
 - b. CRD-C621, Specification for Nonshrink Grout

1.2 SUBMITTALS

A. Shop Drawings:

1. Product data of grouts.
2. Proposed method for keeping existing concrete surfaces wet prior to placing grout.
3. Forming method for fluid grout placements.
4. Curing method for grout.

B. Quality Control Submittals:

1. Manufacturer's Written Instructions.
2. Manufacturer's Certificate of Compliance:
 - a. Grout free from chlorides and other corrosion-causing chemicals.
 - b. Nonshrink grout properties of Categories II and III, verifying expansion at 3 or 14 days will not exceed the 28 day expansion and nonshrink properties are not based on gas or gypsum expansion.
3. Test Reports: Test report for 24-hour evaluation of nonshrink grout. Independent

testing laboratory to certify that testing was conducted within the past 18 months.

1.3 GUARANTEE

- A. Manufacturer's guarantee shall not contain disclaimer on the product data sheet, grout bag, or container limiting responsibility to only the purchase price of products and materials furnished.
- B. Manufacturer guarantees participation with CONTRACTOR in replacing or repairing grout found *defective* due to faulty materials, as determined by industry standard test methods.

PART 2 PRODUCTS

2.1 NONSHRINK GROUT SCHEDULE

- A. Furnish nonshrink grout for applications in grout category in the following schedule:

Application	Temperature Range	Max. Placing Time	
	40 to 100 deg F	20 min	Greater than 20 min
Filling tie holes	I	I	I
Column baseplates single-story	I or II		II
Machine bases 25 hp or less	II	II	II
Baseplates for columns over one story	II	II	II
Patching concrete walls	II	II	II
Machine bases 26 hp and up	III	III	III

2.2 NONSHRINK GROUT

- A. Category I:
 - 1. Nonmetallic and nongas-liberating flowable fluid.
 - 2. Prepackaged natural aggregate grout requiring only the addition of water.
 - 3. Test in accordance with ASTM C1107:
 - a. Flowable consistency 140 percent, five drops in 30 seconds, in accordance with ASTM C230.
 - b. Flowable for 15 minutes.

4. Grout shall not bleed at maximum allowed water.
5. Minimum strength of grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
6. Manufacturers and Products:
 - a. Master Builders Co., Cleveland, OH; SET GROUT.
 - b. Euclid Chemical Co., Cleveland, OH; NS Grout.
 - c. Dayton Superior Corp., Miamisburg, OH; Sure-Grip High Performance Grout.

B. Category II:

1. Nonmetallic, nongas-liberating flowable fluid.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with COE CRD-C621 and ASTM C1107, Grade B:
 - a. Fluid consistency 20 to 30 seconds in accordance with COE CRD-C611.
 - b. Temperatures of 40, 80, and 100 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of grout, 2,500 psi at 1 day, 4,500 psi at 3 days, and 7,000 psi at 28 days.
7. Maintain fluid consistency when mixed in 1 to 9 yard loads in ready-mix truck.
8. Manufacturers and Products:
 - a. Master Builders Co., Cleveland, OH; Master Flow 928.
 - b. Five Star Products Inc., Fairfield, CT; Five Star 100.
 - c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.

C. Category III:

1. Metallic and nongas-liberating flowable fluid.

2. Prepackaged aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with COE CRD-C621 and ASTM C1107, Grade B:
 - a. Fluid consistency 20 to 30 seconds in accordance with COE CRD-C611.
 - b.. Temperatures of 40 and 100 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of grout, 4,000 psi at 1 day, 5,000 psi at 3 days, and 9,000 psi at 28 days.
7. Maintain fluid consistency when mixed in 1 to 9 yard loads in ready-mix truck.
8. Manufacturers and Products: Master Builders Co., Cleveland, OH; EMBECO 885.

PART 3 EXECUTION

3.1 NONSHRINK GROUT

- A. General: Mix, place, and cure nonshrink grout in accordance with grout manufacturer's representative training instructions.
- B. Form Tie Holes: Provide nonshrink grout, Category I and II, fill space with dry pack dense grout hammered in with steel tool and hammer.
- C. Grouting Machinery Foundations:
 1. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material.
 2. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts
 3. Form with watertight forms at least 2 inches higher than bottom of plate.
 4. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's representative training instructions.

END OF SECTION

GROUT

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SECTION 04200 - UNIT MASONRY

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

Clay unit masonry in the form of brick.

Concrete unit masonry, including unit masonry with vertical reinforcement.

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

Division 2 Section "Unit Pavers" for exterior applications.

Division 5 Section "Expansion Joint Cover Assemblies" for expansion joint cover assemblies.

Products installed but not furnished under this Section include the following:

Steel lintels in unit masonry are specified in Division 5 Section "Metal Fabrications."

Wood nailers and blocking built into unit masonry are specified in Division 6 Section "Rough Carpentry".

Hollow metal frames in unit masonry openings are specified in Division 8 Section "Steel Doors and Frames."

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product data for each different masonry unit, accessory, and other manufactured product indicated.

Shop drawings for reinforcing detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315 "Details and Detailing of Concrete Reinforcing" showing bar schedules, stirrup spacing, diagrams of bent bars, lateral ties, and arrangement of masonry reinforcement.

Samples for initial selection purposes of the following:

Unit masonry samples in small-scale form showing full extent of colors and textures available for each different exposed masonry unit required.

Samples for verification purposes of the following:

Full-size units for each different exposed masonry unit required showing full range of exposed color, texture, and dimensions to be expected in completed construction.

Include size variation data verifying that actual range of sizes for brick falls within ASTM C 216 dimension tolerances for brick where modular dimensioning is indicated.

Accessories embedded in the masonry.

Material certificates for the following signed by manufacturer and Contractor certifying that each material complies with requirements.

Each different cement product required for mortar and grout including name of manufacturer, brand, type, and weight slips at time of delivery.

Each material and grade indicated for reinforcing bars.

Each type and size of joint reinforcement.

Each type and size of anchors, ties, and metal accessories.

Cold-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

Hot-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

QUALITY ASSURANCE

Unit Masonry Standard: Comply with ACI 530.1/ASCE 6 "Specifications for Masonry Structures," except as otherwise indicated.

Special inspection services to inspect foundations for compliance with dimensional tolerances as specified in the referenced unit masonry standard will not be required.

Fire Performance Characteristics: Where indicated, provide materials and construction identical to those of assemblies whose fire resistance has been determined per ASTM E 119 by a testing and inspecting organization, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

Single-Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and

color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

DELIVERY, STORAGE, AND HANDLING

Deliver masonry materials to project in undamaged condition.

Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.

Store cementitious materials off the ground, under cover, and in dry location.

Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

Store masonry accessories including metal items to prevent corrosion and accumulation of dirt and oil.

PROJECT CONDITIONS

Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

Brace all walls during erection and provide protection against damage from wind and weather.

Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar, and soil that come in contact with such masonry.

Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

Protect sills, ledges, and projections from mortar droppings.

Protect surfaces of window and door frames, as well as similar products with painted and integral finishes from mortar droppings.

Cold-Weather Construction: Comply with referenced unit masonry standard for cold-weather construction and the following:

Do not lay masonry units that are wet or frozen.

Remove masonry damaged by freezing conditions.

Hot-Weather Construction: Comply with referenced unit masonry standard.

PART 2 - PRODUCTS

MATERIALS, GENERAL

Comply with referenced unit masonry standard and other requirements specified in this Section applicable to each material indicated.

CLAY MASONRY UNITS

General: Comply with the following requirements applicable to each form of brick required:

Provide units without cores or frogs and with all exposed surfaces finished for ends of window sills, caps, and similar applications that expose brick surfaces that otherwise would be concealed from view.

Face Brick Standard: ASTM C 216 and as follows:

Grade SW.

Size: Provide bricks manufactured to the following actual dimensions within the tolerances specified in ASTM C 216:

Standard Modular: 3-5/8 inches thick by 2-1/4 inches high by 7-5/8 inches long.

Exterior and Interior Applications for Field and Accent Face Brick: Use where brick is exposed, unless otherwise indicated.

Field Face Brick: Acme Brick, PEP BL600, Oxford Brown Velour or approved equal.

Accent Face Brick: Kansas Brick and Tile, 500 Cocoa Modular or approved equal.

All face brick color selections shall be approved by Contracting Officer.

Building (Common) Brick: ASTM C 62, and as follows:

Grade MW or Grade SW.

Size: Provide bricks manufactured to the following actual dimensions within the tolerances specified in ASTM C 216:

Match size specified for face brick.

Application: Use where brick is indicated for concealed locations.

CONCRETE MASONRY UNITS

General: Comply with requirements indicated below applicable to each form of concrete masonry unit required.

Provide special shapes where indicated and as follows:

For lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.

Square-edged units for outside corners, except where indicated as bullnose.

Size: Provide concrete masonry units complying with requirements indicated below for size that are manufactured to specified face dimensions within tolerances specified in the applicable referenced ASTM specification for concrete masonry units.

Concrete Masonry Units: Manufactured to specified dimensions of 3/8 inch less than nominal widths by nominal heights by nominal lengths indicated on drawings. Typical nominal face dimensions of 16" long x 8" high (15-5/8" x 7-5/8" actual) x thickness indicated.

Provide Type I, moisture-controlled units.

Hollow Load-Bearing Concrete Masonry Units: ASTM C 90, Grade N and as follows:

Unit Compressive Strength: Provide units with minimum average net area compressive strength indicated below:

2000 psi.

Weight Classification: Lightweight.

Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

MORTAR AND GROUT MATERIALS

Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color cement.

Masonry Cement: Masonry cement shall NOT be used.

Hydrated Lime: ASTM C 207, Type S.

Aggregate for Mortar: ASTM C 144, except for joints less than 1/4 inch use aggregate graded with 100 percent passing the No. 16 sieve.

Aggregate for Grout: ASTM C 404 or ASTM C 33, Size No. 1.

Water: Clean and potable.

Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars. Two mortar pigment colors will be selected, one for field face brick and another for accent face brick.

Products: Subject to compliance with requirements, provide one of the following:

Mortar Pigments:

True Tone Mortar Colors; Davis Colors.
Centurion Pigments; Lafarge Corporation.
SGS Mortar Colors; Solomon Grind-Chem Services, Inc.

REINFORCING STEEL

General: Provide reinforcing steel complying with requirements of referenced unit masonry standard and this article.

Steel Reinforcing Bars: Material and grade as follows:

Billet steel complying with ASTM A 615.

Grade 60.

Shop-fabricate reinforcing bars shown to be bent or hooked.

JOINT REINFORCEMENT

General: Provide joint reinforcement complying with requirements of referenced unit masonry standard and this article, formed from the following:

Zinc-Coated (Galvanized) Steel Wire: ASTM A 82 for uncoated wire and with ASTM A 641 for

zinc coating of class indicated below:

Class 1 (0.40 oz. per square foot of wire surface).

Application: Use for interior masonry walls.

Hot-Dip Galvanized Steel Wire: ASTM A 82 for uncoated wire and with ASTM A 153, Class B-2 (1.5 oz. per square foot of wire surface) for zinc coating applied after prefabrication into units.)

Application: Use for exterior masonry walls.

Description: Welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with requirements indicated below:

Width: Fabricate joint reinforcement in units with widths of approximately 2" less than nominal width of walls and partitions as required to provide mortar coverage of not less than 5/8" on joint faces exposed to exterior and 1/2" elsewhere.

Wire Diameter for Side Rods: 0.1483 inch (9 gage).

Wire Diameter for Cross Rods: 0.1483 inch (9 gage).

For single-wythe masonry provide type as follows with single pair of side rods:

Truss design with continuous diagonal cross rods spaced not more than 16 inches o.c.

For multiwythe masonry provide type as follows:

Tab design with single pair of side rods and rectangular box-type cross ties spaced not more than 16 inches o.c.; with side rods spaced for embedment within each face shell of backup wythe and ties extended to engage the outer wythe by at least 1-1/2 inches.

Use units with adjustable 2-piece rectangular ties at exterior walls and as indicated.

Manufacturers: Subject to compliance with requirements, provide joint reinforcement by one of the following:

AA Wire Products Co.
Dur-O-Wal, Inc.
Heckman Building Products, Inc.
Hohmann & Barnard, Inc.
National Wire Products Industries.

TIES AND ANCHORS, GENERAL

General: Provide ties and anchors specified in subsequent articles that comply with requirements for metal and size of referenced unit masonry standard and of this article.

Galvanized Carbon Steel Wire: ASTM A 82, coating class as required by referenced unit masonry standard, for wire ties and anchors in interior walls, unless otherwise indicated.

Wire Diameter: 0.1875 inch.

Galvanized Steel Sheet:

ASTM A 366 (commercial quality) cold-rolled carbon steel sheet, hot-dip galvanized after fabrication to comply with ASTM A 153, Class B2 (for unit lengths over 15 inches) and Class B3 (for unit lengths under 15 inches), for sheet metal ties and anchors exposed to the weather and not completely embedded in mortar and grout.

Thickness of Steel Sheet Galvanized After Fabrication: Uncoated thickness of steel sheet hot-dip galvanized after fabrication: 0.0598 inch (16 gage).

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

AA Wire Products Co.
Dur-O-Wal, Inc.
Heckman Building Products, Inc.
Hohmann & Barnard, Inc.
National Wire Products Industries.

BENT WIRE TIES

Individual units prefabricated from bent wire.

Type for Masonry Where Coursing Between Wythes Align: Unit ties bent from one piece of wire.

Type for Masonry Where Coursing Between Wythes Does Not Align: Adjustable ties composed of two parts, one with pintles, the other with eyes, maximum misalignment 1-1/4 inches.

ADJUSTABLE ANCHORS FOR CONNECTING MASONRY TO STRUCTURAL FRAMEWORK

General: Two-piece assemblies as described below allowing vertical or horizontal differential movement between wall and framework parallel to plane of wall, but resisting tension and compression forces perpendicular to it.

For anchorage to steel framework provide manufacturer's standard anchors with crimped 1/4-inch-diameter wire anchor section for welding to steel and triangular-shaped wire tie section sized to extend within 1 inch of masonry face and as follows:

Wire Diameter: 0.1875 inch.

EMBEDDED FLASHING MATERIALS

Copper-Fabric Laminate: Copper sheet of weight per sq. ft. indicated below, bonded with asphalt between 2 layers of glass fiber cloth.

Weight: 5 oz.

Application: Use where flashing is fully concealed in masonry.

Adhesive for Flashings: Of type recommended by manufacturer of flashing material for use indicated.

Products: Subject to compliance with requirements, provide one of the following:

Copper Fabric Laminate Flashing:

"Copper Fabric," Afco Products Inc.

"York Copper Fabric Flashing," York Manufacturing, Inc.

MISCELLANEOUS MASONRY ACCESSORIES

Nonmetallic Expansion Joint Strips: Premolded filler strips complying with ASTM D 1056, Type 2 (closed cell), Class A (cellular rubber and rubber-like materials with specific resistance to petroleum base oils), Grade 1 (compression-deflection range of 2-5 psi), compressible up to 35 percent, of width and thickness indicated.

Equal to W.R. Meadows, "Ceramar Flexible Foam".

Preformed Control Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

Styrene-Butadiene Rubber Compound: ASTM D 2000, Designation 2AA-805. Equal to Dur-O-Wall, "Regular".

Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

Weep Holes: Provide the following:

Wicking Material: Material as indicated below, in length required to produce 1/2 inch exposure on exterior and 12 inches in cavity between wythes:

Cotton sash cord.

Trim cotton cord flush with wall following final cleaning.

INSULATION

Extruded Polystyrene Board Insulation: Rigid cellular polystyrene thermal insulation with closed cells and integral high-density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578, Type IV; in manufacturer's standard lengths and widths; thicknesses as indicated.

Products: Subject to compliance with requirements, provide one of the following:

"Styrofoam SM/SB"; Dow Chemical USA
"Foamular 250"; UC Industries.
"Certifoam"; Minnesota Diversified Products, Inc.

Adhesive: Type recommended by insulation board manufacturer for application indicated.

MASONRY CLEANERS

Job-Mixed Detergent Solution: Solution of trisodium phosphate (1/2-cup dry measure) and laundry detergent (1/2-cup dry measure) dissolved in one gallon of water.

Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by manufacturer of masonry units being cleaned.

Acidic cleaner shall be used only if approved by face brick manufacturer.

Products: Subject to compliance with requirements, provide the following:

"Sure Klean No. 600 Detergent," ProSoCo, Inc.

MORTAR AND GROUT MIXES

General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

Do not use calcium chloride in mortar or grout.

Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification for mortar types indicated below:

Limit cementitious materials in mortar to portland cement-lime.

Type S: Over 1/4 up to 1/2 part lime per one part of portland cement and 3 to 4-1/2 parts sand.

UNIT MASONRY

All mortar at interior CMU walls, including interior wythe of exterior walls, shall be Type S, natural-colored mortar.

Type N: One part lime per one part of portland cement and 4-1/2 to 6 parts sand.

All mortar for field face brick and accent face brick block shall be Type N, colored mortar.

Pigmented Mortar: Select and proportion pigments with other ingredients to produce color as selected by Contracting Officer from manufacturer's full range of colors.

Limit pigments to the following percentages of cement content by weight:

For mineral oxide pigments and portland cement-lime mortar, not more than 10 percent.

Grout for Unit Masonry: Comply with ASTM C 476 and referenced unit masonry standard for grout in construction of reinforced and non-reinforced unit masonry.

Use grout of consistency indicated or if not otherwise indicated, of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout.

Use fine grout in grout spaces less than 2" in horizontal direction, unless otherwise indicated.

Use coarse grout in grout spaces 2" or more in least horizontal dimension, unless otherwise indicated.

All grout for vertical reinforcement and bond beams shall be 3000 psi concrete unless otherwise approved by Contracting Officer. Design mix shall be as indicated in General Structural Notes. Test cylinders in accordance with Section 03310.

PART 3 - EXECUTION

EXAMINATION

Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry.

Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

Do not proceed until unsatisfactory conditions have been corrected.

INSTALLATION, GENERAL

Comply with referenced unit masonry standard and other requirements indicated applicable to each type of installation included in Project.

Wetting Clay Brick: Wet brick made from clay or shale which have ASTM C 67 initial rates of absorption (suction) of more than 30 grams per 30 square inches per minute. Use wetting methods which ensure each clay masonry unit being nearly saturated but surface dry when laid.

Do not wet concrete masonry units.

Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.

Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

Build chases and recesses as shown or required to accommodate items specified in this and other Sections of the Specifications, including work of other trades. Provide not less than 8 inches of masonry between chase or recess and jamb of openings and between adjacent chases and recesses.

Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.

Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting where possible.

CONSTRUCTION TOLERANCES

Comply with construction tolerances of referenced unit masonry standard.

LAYING MASONRY WALLS

Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.

Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

Running bond with vertical joint in each course centered on units in courses above and below, with special bond pattern as indicated at exterior face brick.

Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

Stopping and Resuming Work: In each course, rack back 1/2-unit length for one-half running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly (if required), and remove loose masonry units and mortar prior to laying fresh masonry.

Built-In Work: As construction progresses, build-in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.

Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

Fill cores in hollow concrete masonry units with grout 3 courses (24 inches) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

Rake back mortar at all inside corners of walls and caulk joint with sealant to match appearance of adjacent tooled mortar joints.

MORTAR BEDDING AND JOINTING

Lay solid brick size masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

Lay hollow concrete masonry units as follows:

With full mortar coverage on horizontal and vertical face shells.

Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.

For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.

Cut joints flush for masonry walls to be concealed or to be covered by other materials, unless otherwise indicated.

Tool exposed joints slightly concave using a jointer larger than joint thickness, unless otherwise indicated. Rake out mortar in preparation for application of sealants where shown or specified.

Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

Piers, columns and wall ends shall be laid with regular joint widths regardless of nominal dimensions shown on the drawings. Fat joints will not be permitted.

STRUCTURAL BONDING OF MULTI-WYTHE MASONRY

Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes.

Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.

Provide continuity with horizontal joint reinforcement at corners using prefabricated "L" units, in addition to masonry bonding.

Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:

Provide continuity with horizontal joint reinforcement using prefabricated "T" units.

Nonbearing Interior Partitions: Build full height of story to underside of solid floor or roof structure above and as follows:

Install pressure-relieving joint filler in joint between top of partition and underside of structure above.

CAVITIES/AIR SPACES

Keep cavities/air spaces clean of mortar droppings and other materials during construction. Strike joints facing cavities/air spaces flush.

Tie exterior wythe to backup with continuous horizontal joint reinforcing using adjustable 2-piece rectangular ties, installed in mortar joints at not more than 16 inches o.c. vertically.

CAVITY WALL INSULATION

On units of plastic insulation, install small pads of adhesive spaced approximately 1'-0" o.c. both ways on inside face or attach to inside face with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

Fill all cracks and open gaps in insulation with crack sealer compatible with insulation and

masonry.

HORIZONTAL JOINT REINFORCEMENT

General: Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcing a minimum of 6 inches.

Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, pipe enclosures, and other special conditions.

Reinforce walls with continuous horizontal joint reinforcement.

Space continuous horizontal reinforcement to comply with referenced unit masonry standard and as follows:

For multi-wythe walls (solid or cavity) where continuous horizontal reinforcement acts as structural bond or tie between wythes, space reinforcement as required by code or standard but not more than 16" o.c. vertically.

For single-wythe walls, space reinforcement at 16" o.c. vertically, unless otherwise indicated.

For parapets, space reinforcement at 8" o.c. vertically, unless otherwise indicated.

Reinforce masonry openings greater than 1'0" wide, with horizontal joint reinforcement placed in 2 horizontal joints approximately 8" apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'0" beyond jambs of the opening except at control joints.

In addition to wall reinforcement, provide additional reinforcement at openings as required to comply with the above.

ANCHORING MASONRY TO STRUCTURAL MEMBERS

Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.

Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.

Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c.

horizontally.

MOVEMENT (CONTROL AND EXPANSION) JOINTS

General: Install control and expansion joints in unit masonry where indicated. Build in related items as the masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

Form control joints in masonry as follows:

Install preformed control joint gaskets designed to fit standard sash block.

Build in joint fillers where indicated.

Form open joint of width indicated but not less than 3/8 inch for installation of sealant and backer rod specified in Division 7 Section "Joint Sealers." Maintain joint free and clear of mortar.

LINTELS

Install steel lintels where indicated.

Provide masonry lintels where shown and wherever openings of more than 1'-0" for brick size units and 2'-0" for block size units are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.

For hollow concrete masonry unit walls, use specially formed bond beam units with reinforcement bars placed as indicated and filled with coarse grout.

Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

FLASHING/WEEP HOLES

General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.

Prepare masonry surfaces so that they are smooth and free from projections that could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with adhesive/sealant/tape as recommended by flashing manufacturer before covering with mortar.

Install flashings to comply with manufacturer's instructions and as follows:

At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4 inches, and through the inner wythe to within 1/2 inches of the interior face of the

wall in exposed masonry. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2 inches, unless otherwise indicated.

At heads and sills, extend flashing as specified above unless otherwise indicated but turn up ends not less than 2 inches to form a pan.

Cut off flashing flush with face of wall after masonry wall construction is completed.

Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashings and as follows:

Form weep holes with product specified in Part 2 of this Section.

Space weep holes 24 inches o.c.

Install reglets and nailers for flashing and other related construction where shown to be built into masonry.

INSTALLATION OF REINFORCED UNIT MASONRY

General: Install reinforced unit masonry to comply with requirements of referenced unit masonry standard.

Placing Reinforcement: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.

Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 1" (whichever is greater).

Splice reinforcement bars where shown; do not splice at other points unless acceptable to the Contracting Officer. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.

Provide not less than minimum lap indicated.

Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.

Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical

cells, or provide units with solid bottoms.

Use "Fine Grout" per ASTM C 476 for filling spaces less than 4" in one or both horizontal directions.

Use "Coarse Grout" per ASTM C 476 for filling 4" spaces or larger in both horizontal directions.

Grouting Technique: Use low-lift grouting techniques subject to requirements which follow:

Provide minimum clear dimension of 2" and clear area of 8 square inches in vertical cores to be grouted.

Place vertical reinforcement prior to grouting cores of CMU. Extend above elevation of maximum grout height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters nor 10 ft.

Do not exceed 4' height, or if bond beam occurs below 4' height, stop pour at course below bond beam.

Grout cores using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout placing 1-1/2" below top course of pour.

Bond Beams: Stop grout in vertical cells 1-1/2" below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

REPAIRING, POINTING, AND CLEANING

Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.

Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.

Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Contracting Officer's approval of sample cleaning before proceeding with cleaning of masonry.

Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.

Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.

Clean brick by means of bucket and brush hand-cleaning method described in BIA "Technical Note No. 20 Revised" using the following masonry cleaner:

Job-mixed detergent solution.

Proprietary acidic cleaner; apply in compliance with directions of acidic cleaner manufacturer. Acidic cleaner shall be used only if approved by face brick manufacturer.

Clean concrete masonry by means of cleaning method indicated in NCMA TEK 45 applicable to type of stain present on exposed surfaces.

Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

END OF SECTION 04200

SECTION 05310 - STEEL DECK

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

Steel roof deck.

Noncomposite steel form deck.

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

Division 3 Section "Cast-in-Place Concrete" for concrete fill and reinforcing steel.

Division 5 Section "Metal Fabrications" for framing openings with miscellaneous steel shapes.

SUBMITTALS

General: Submit each item in this Article according to the Conditions of Contract and Division 1 Specification Sections.

Product data for each type of deck, accessory, and product specified.

Shop drawings showing layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories and attachments to other construction.

Product Certificates signed by manufacturers of steel deck certifying that their products comply with specified requirements.

Welder certificates certifying that welders comply with requirements specified under the "Quality Assurance" Article.

Product test reports from qualified independent testing agencies evidencing compliance with requirements of the following based on comprehensive testing:

Mechanical fasteners.

QUALITY ASSURANCE

Installer Qualifications: Engage an experienced Installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and with a record of successful performance.

Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel."

Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved. AWS qualification testing shall be no later than 5 years.

Fire-Test-Response Characteristics: Where indicated, provide steel deck panels identical to those tested as part of an assembly for fire resistance per ASTM E 119 by a testing and inspection agency performing testing and follow-up services, that is acceptable to authorities having jurisdiction.

Fire-Resistance Ratings: As indicated by design designations listed in UL "Fire Resistance Directory," or by Warnock Hersey or another testing and inspecting agency.

Labeling: Identify steel deck with appropriate markings of applicable testing and inspecting agency.

FM Listing: Provide steel roof deck evaluated by Factory Mutual and listed in Factory Mutual "Approval Guide" for Class 1 fire rating and Class 1-90 windstorm ratings.

DELIVERY, STORAGE, AND HANDLING

Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products of one of the following:

Vulcraft Div. of Nucor Corp.
Wheeling Corrugating Co., Div. of Wheeling-Pittsburgh Steel Corp.

ROOF DECK

Steel Roof Deck: Fabricate panels without top-flange stiffening grooves conforming to SDI Publication No. 28 "Specifications and Commentary for Steel Roof Deck" and the following:

Prime-Painted Steel Sheet: ASTM A 611, Grade C, shop primed as follows:
Shop Primer: Grey or white baked-on, lead-and chromate-free rust-inhibitive primer, conforming to the performance requirements of Fed. Spec. TT-P-664.

Deck Profile: Type WR, wide.

Profile Depth: 1-1/2 inches.

Design Uncoated-Steel Thickness: Refer to Structural Drawings for deck gage.

Span Condition: As indicated.

Side Joints: Overlapped.

FORM DECK

Noncomposite Steel Form Deck: Fabricate ribbed-steel sheet noncomposite form deck panels conforming to SDI Publication No 28 "Specifications and Commentary for Noncomposite Steel Form Deck," the minimum section properties indicated, and the following:

Galvanized-Steel Sheet: ASTM A 446, Grade E, G 60 (ASTM A 446M, Grade E, Z 180) zinc coated according to ASTM A 525 (ASTM A 525M).

Profile Depth: 1-1/2 inches.

Design Uncoated-Steel Thickness: 20 gage.

Span Condition: As indicated.

Side Joints: Overlapped.

ACCESSORIES

General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.

Side Lap Fasteners: Manufacturer's standard, corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 minimum diameter.

Rib Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

Miscellaneous Roof Deck Accessories: Steel sheet, 0.0359-inch-thick plates, finish strips, and reinforcing channels, of same material as roof deck.

Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.

Weld Washers: Manufacturer's standard uncoated-steel sheet weld washers, shaped to fit deck rib, 0.0598 inch thick with 3/8-inch minimum diameter prepunched hole.

Flat Receiver Pan: Manufacturer's standard size, single-piece steel sheet, 0.071-inch thick minimum, of same material as deck panels. Cut holes for drains in the field.

Steel Sheet Accessories: ASTM A 446, G 60 (ASTM A 446M, Z 180) coating class, galvanized according to ASTM A 525 (ASTM A 525M).

Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

EXAMINATION

Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

PREPARATION

Locate decking bundles to prevent overloading of supporting members.

INSTALLATION, GENERAL

Install deck panels and accessories according to applicable specifications and commentary of SDI Publication No. 28, manufacturer's recommendations, requirements of this Section, and as indicated on Structural Drawings.

Install temporary shoring before placing deck panels when required to meet deflection limitations.

Place deck panels on supporting framing and adjust to final position with ends accurately aligned and bearing on supporting framing before being permanently fastened. Do not stretch or contract side lap interlocks.

Place deck panels flat and square and fasten to supporting framing without warp or deflection.

Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to the decking.

Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

Provide firestopping between bottom of steel deck and top of rated walls and partitions to maintain integrity of fire-resistive construction. Refer to Section 07270.

ROOF DECK INSTALLATION

Fasten roof deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

Weld Diameter: 5/8 inch nominal.

Weld Spacing: Space and locate welds as indicated on Structural Drawings.

Weld Washers: Install weld washers at each location on 22 gage deck.

Side Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals indicated on structural drawings, using one of the following methods:

Mechanically fasten with self-drilling No. 10-diameter or larger carbon steel screws.

End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1-1/2 inches with end joints as follows:

End Joints: Lapped 2 inches minimum.

Roof Receiver Pans: Install over openings provided in roof decking, and secure flanges to top of deck. Space fasteners not more than 12 inches apart with at least one fastener at each corner.

Miscellaneous Roof Deck Accessories: Install finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's recommendations. Weld to substrate to provide a complete deck installation.

Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's instructions to ensure complete closure.

Provide firestopping as required to maintain integrity of fire-resistive construction.

REPAIRS AND PROTECTION

Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces with galvanized repair paint according to ASTM A 780 and the manufacturer's instructions.

Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on both surfaces of installed deck panels.

Touch up painted surfaces with same type of shop paint used on adjacent surfaces.

Where shop-painted surfaces are exposed, apply touchup paint to blend into adjacent surfaces.

Provide final protection and maintain conditions to ensure steel decking is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05310

SECTION 05500 - METAL FABRICATIONS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Division 1 Specification Sections, apply to work of this Section.

SUMMARY

This Section includes the following metal fabrications:

- Rough hardware.

- Ladders.

- Ships ladders.

- Loose bearing and leveling plates.

- Loose steel lintels.

- Miscellaneous framing and supports including, but not limited to, the following:

 - Hangers.

 - Bridge crane supports.

 - Overhead coiling door supports.

 - Miscellaneous framing for roof openings.

 - Support framing and angles for wall panels.

 - Sill angles at coiling and hangar doors.

 - Miscellaneous framing for window and door openings.

 - Miscellaneous framing at roof transition.

 - Miscellaneous framing and support at landing for access ladder to mechanical platform.

 - Support for mechanical units on roof.

 - Miscellaneous support to brace top of CMU walls.

 - Electrical transformer support frames.

 - Miscellaneous supports for mechanical and electrical equipment.

 - Miscellaneous panel supports.

 - Steel angles and supports for gutter framing.

- Miscellaneous framing and supports for hangar doors including but not limited to the following:

Frames and supports for head, jamb and mullion.
Mullion pit steel for attachment of guide rails.
Header boxes.
Hoist motor platforms.
Sheave plates.
Limit switch brackets.
Mullion pit steel.
Support for mullion lifting motors.
Safety arrestor supports.

Steel railings and guardrails.

Metal bar gratings.

Floor plates.

Metal pipe bollards.

Steel cornerguards at door openings.

Closure plates and angles at columns.

Related Sections: The following sections contain requirements that relate to this section:

Division 5 Section "Structural Steel" for structural steel framing system components.

Division 7 Section "Building Insulation" for insulation in built-up steel; lintels.

Definitions

Definitions in ASTM E 985 for railing-related terms apply to this section.

SYSTEM PERFORMANCE REQUIREMENTS

Structural Performance of Handrails and Railing Systems: Design, engineer, fabricate, and install handrails and railing systems to comply with requirements of ASTM E 985 for structural performance based on testing performed in accordance with ASTM E 894 and E 935.

Ship's Ladder: Capable of withstanding a uniform load of 100 lbf per sq. ft. or a concentrated load of 300 lbf on a area of 4 sq. inches located in the center of the tread, whichever produces the greater stress.

Access Platform: Capable of withstanding a uniform load of 100 lbf per sq. ft.

SUBMITTALS

METAL FABRICATIONS

Product data for products used in miscellaneous metal fabrications, including paint products and grout.

Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.

Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for their preparation.

Samples representatives of materials and finished products as may be requested by Architect.

Welder certificates certifying that welders comply with requirements specified under "Quality Assurance" article.

For field welding operations, certify that each welder has satisfactorily passed AWS qualification tests for welding process involved. AWS qualification testing shall be no later than 5 years.

QUALITY ASSURANCE

Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar to that indicated for this Project.

Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel"; D1.3 "Structural Welding Code - Sheet Steel"; and, D1.2 "Structural Welding Code - Aluminum."

PROJECT CONDITION

Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

FERROUS METALS

Metal Surfaces, General: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use

METAL FABRICATIONS

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materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.

Steel Plates, Shapes, and Bars: ASTM A 36.

Steel Bars for Gratings: ASTM A 509 or ASTM A 36.

Steel Tubing: Product type (manufacturing method) and as follows:

Cold-Formed Steel Tubing: ASTM A 500, grade as indicated below:

Grade B, unless otherwise indicated or required for design loading.

Uncoated Structural Steel Sheet: Product type (manufacturing method), quality, and grade, as follows:

Grade A, unless otherwise indicated or required by design loading.

Steel Pipe: ASTM A 53; finish, type, and weight class as follows:

Black finish, unless otherwise indicated.

Type S, Grade B, standard weight (schedule 40), unless otherwise indicated.

Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.

Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

E70XX electrodes shall be used for all welding.

GROUT

Nonshrink Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD-C 621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.

Products: Subject to compliance with requirements, provide one of the following:

"Euco N-S Grout"; Euclid Chemical Co.
"Crystex"; L&M Construction Chemicals, Inc.
"Masterflow 713"; Master Builders.
"Five Star Grout"; U.S. Grout Corp.

FASTENERS

General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.

Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.

Lag Bolts: Square head type, FS FF-B-561.

Machine Screws: Cadmium plated steel, FS FF-S-92.

Wood Screws: Flat head carbon steel, FS FF-S-111.

Plain Washers: Round, carbon steel, FS FF-W-92.

Drilled-In Expansion Anchors: Expansion anchors complying with FS FF-S-325, Group VIII (anchors, expansion, [nondrilling]), Type I (internally threaded tubular expansion anchor); and machine bolts complying with FS FF-B-575, Grade 5.

Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class, and style as required.

Lock Washers: Helical spring type carbon steel, FS FF-W-84.

PAINT

Shop Primer for Ferrous Metal: Manufacturer's or fabricator's standard, fast-curing, lead-free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure complying with performance requirements of FS TT-P-664.

Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 except containing no asbestos fibers.

Zinc Chromate Primer: FS TT-P-645.

CONCRETE FILL AND REINFORCING MATERIALS

Concrete Materials and Properties: Comply with requirements of Division 3 section "Cast in Place Concrete" for normal weight, ready-mix concrete with minimum 28-day compressive strength of 3,000 psi.

METAL FABRICATIONS

Reinforcing Bars: ASTM A 615, Grade 60, unless otherwise indicated.

FABRICATION, GENERAL

Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

Shear and punch metals cleanly and accurately. Remove burrs.

Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

Remove sharp or rough areas on exposed traffic surfaces.

Weld corners and seams continuously to comply with AWS recommendations and the following:

Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

Obtain fusion without undercut or overlap.

Remove welding flux immediately.

At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

Cut, reinforce, drill and tap miscellaneous metal work as required to receive finish hardware, screws, and similar items.

Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

ROUGH HARDWARE

Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 sections.

Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

STEEL LADDERS

General: Fabricate ladders for the locations shown, with dimensions, spacings, details and anchorages as indicated. Comply with requirements of ANSI A 14.3.

Side Rails: Continuous steel flat bars, ½ inch x 2-1/2 inches, with eased edges, spaced 18 inches apart.

Bar Rungs: Round steel bars, 3/4 inch diameter, spaced 12 inches o.c.

Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.

Support each ladder at top and bottom and at intermediate points spaced not more than 5'-0" o.c. by means of welded or bolted steel brackets.

Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 7 inches.

Extend side rails 42 inches above top rung, and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, goose-neck the extended rails back to the structure to provide secure ladder access.

SHIP'S LADDERS

Provide ship's ladders where indicated. Fabricate of open type construction with structural steel channel stringers, steel pipe handrails, and open steel grating treads, unless otherwise indicated. Provide brackets and fittings for installation.

LOOSE BEARING AND LEVELING PLATES

Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required.

METAL FABRICATIONS

LOOSE STEEL LINTELS

Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

Size loose lintels for equal bearing of one inch per foot of clear span but not less than 8 inches bearing at each side of openings, unless otherwise indicated.

Fabricate with insulation placed between steel members as indicated.

MISCELLANEOUS FRAMING AND SUPPORTS

General: Provide steel framing and supports for applications indicated or which are not a part of structural steel framework, as required to complete work.

Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.

Except as otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide x 1/4 inch x 8 inches long.

STEEL PIPE RAILINGS AND HANDRAILS

General: Fabricate pipe railings and handrails to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.

Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.

At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.

Form changes in direction of railing members as follows:

By radius bends.

Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

METAL FABRICATIONS

Provide wall returns at ends of wall-mounted handrails.

Close exposed ends of pipe by welding 3/16 inch thick steel plate in place or by use of prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 1/4 inch or less.

Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.

For steel railings formed from steel pipe with black finish, provide non galvanized ferrous metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

METAL BAR GRATINGS

General: Produce metal bar gratings of description indicated per NAAMM marking system that comply with the following:

Metal Bar Grating Standard "Standard Specifications for Metal Bar Grating and Metal Bar Grating Treads" published in ANSI/NAAMM A202.1 "Metal Bar Grating Manual."

Fabricate welded steel gratings to comply with requirements indicated below.

Size: As indicated on Structural Drawings.

Traffic Surface: Plain.

Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz. per sq. ft. of coated surface.

Provide gratings with removable anchoring devices and supplemental supporting steel angle frame as indicated.

PIPE BOLLARDS

Fabricate pipe bollards from Schedule 80 Steel Pipe.

STEEL CORNERGUARDS AT DOOR OPENINGS

Provide steel angle cornerguards at interior column locations as indicated. Secure with counter sunk screws for attachment to framing.

CLOSURE PLATES AND ANGLES AT COLUMNS

Provide steel plates and angles with sizes and configurations as indicated on drawings to provide closure

METAL FABRICATIONS

between steel columns and adjoining masonry construction.

FINISHES, GENERAL

Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

Finish metal fabrications after assembly.

STEEL AND IRON FINISHES

Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

Exteriors (SSPC Zone 1B): SSPC-SP6 "Commercial Blast Cleaning", except SSPC-SP10 "Near-White Blast Cleaning" at exposed surfaces of steel lintels.

Interiors (SSPC Zone 1A): SSPC-SP3 "Power Tool Cleaning", except SSPC-SP10 "Near-White Blast Cleaning" at exposed surfaces of steel lintels.

Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, unless otherwise indicated. Comply with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.

Stripe paint corners, crevices, bolts, welds and sharp edges.

PART 3 - EXECUTION

PREPARATION

Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

INSTALLATION, GENERAL

Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications.

METAL FABRICATIONS

Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:

Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

Obtain fusion without undercut or overlap.

Remove welding flux immediately.

At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

SETTING LOOSE PLATES

Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.

Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

INSTALLATION OF STEEL PIPE RAILINGS AND HANDRAILS

Adjust railings prior to anchoring to ensure matching alignment at abutting joints.

Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 1-½ inch clearance from inside face of handrail and finished wall surface. Locate brackets at indicated, or if not indicated, at spacing required to support structural loads. Secure wall brackets and wall return fittings to building construction as follows:

Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

INSTALLATION OF METAL BAR GRATINGS

General: Install gratings to comply with recommendations of NAAMM grating standard referenced under Part 2 that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

ADJUSTING AND CLEANING

Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.

Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

END OF SECTION 05500

SECTION 05810 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawing and general provisions of Contract, including General and Division 1 Specification Sections, apply to this Section.

SUMMARY

This Section includes the following:

Expansion joint cover assemblies at exterior wall locations in masonry and metal wall panels.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product data in form of manufacturer's product specifications, installation instructions, and general recommendations for each type of expansion joint cover assembly indicated.

Shop drawings showing full extent of expansion joint cover assemblies; include large-scale details indicating profiles of each type of expansion joint cover assembly, splice joints between sections, joinery with other types, special end conditions, anchorages, fasteners, and relationship to adjoining work and finishes. Include description of materials and finishes.

QUALITY ASSURANCE

Manufacturer's Instructions: In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for all phases of work, including preparation of substrate, applying materials, and protection of installed units.

Single-Source Responsibility: Obtain expansion joint cover assemblies from one source from a single manufacturer for installation in conjunction with both masonry and metal wall panel construction.

PART 2 - PRODUCTS

MATERIALS

Metals:

Aluminum: ASTM B 221, alloy 6063-T5 for extrusions; ASTM B 209, alloy 6061-T6, sheet and plate.

Protect aluminum surfaces in contact with cementitious materials with zinc chromate

primer or chromate conversion coating.

Nonmetal Products:

Extruded Preformed Seals: Extruded thermoplastic rubber primary seals retained in extruded aluminum side frames complete with independent continuous PVC back seal.

Colors: To match adjacent wall color.

Accessories: Manufacturer's standard anchors, fasteners, set screws, spacers, flexible filler materials, adhesive, and other accessories compatible with material in contact, as indicated or required for complete installations.

Manufacturer: Subject to compliance with requirements, provide the following:

Exterior Wall Expansion Joint Cover Assembly: Equal to C/S Group, Model SF-400, flush exterior wall seal.

FABRICATION

General: Provide expansion joint cover assemblies of design, basic profile, materials, and operation indicated. Select units comparable to those indicated or required to accommodate joint size, variations in adjacent surfaces, and structural movement. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials. Include closure materials and transition pieces, and other accessories as required to provide continuous joint cover assemblies.

Metal Joint Cover Assemblies: Provide continuous extruded metal frames of profile indicated and concealed bolt and steel anchors for embedment in concrete and attachment to vertical steel members. Provide assemblies formed to receive filler materials. Furnish depth and configuration to suit type of construction indicated.

METAL FINISHES

General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory after products are fabricated. Protect finishes on exposed surfaces with protective covering before shipment.

Aluminum Finishes:

Mill Finish: AA-M10 (unspecified mill finish).

Factory-Primed Concealed Surfaces: Protect concealed metal surfaces that will be in contact with concrete and masonry surfaces when installed by applying a shop coat of manufacturer's standard primer to contact surfaces. Provide minimum dry film thickness of 2.0 mils.

PART 3 - EXECUTION

PREPARATION

Coordinate and furnish anchorages, setting drawings, templates, and instructions for installation of expansion joint cover assemblies to be embedded in concrete and attached to vertical steel members.

INSTALLATION

Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing expansion joint cover assemblies to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and provide for secure attachment of expansion joint cover assemblies.

Cutting, Fitting and Placement: Perform all cutting, drilling, and fitting required for installation of expansion joint covers. Install joint cover assemblies in true alignment and proper relationship to expansion joints and adjoining finished surfaces measured from established lines and levels. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling. Securely attach in place with all required accessories. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches on centers.

Joinery and Continuity: Maintain continuity of expansion joint cover assemblies with end joints held to a minimum and metal members aligned mechanically using splice joints. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames.

CLEANING AND PROTECTION

Do not remove strippable protective material until finish work in adjacent areas is complete. When protective material is removed, clean exposed metal surfaces to comply with manufacturer's instructions.

END OF SECTION 05810

SECTION 06100 - ROUGH CARPENTRY

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Division 1 Specification Sections, apply to work of this Section.

SUMMARY

This Section includes the following:

Miscellaneous curbs.

Wood grounds, nailers and blocking.

Plywood panels.

DEFINITIONS

Rough carpentry includes carpentry work not specified as part of other Sections and which is generally not exposed, except as otherwise indicated.

SUBMITTALS

Wood Treatment Data: Submit chemical treatment manufacturer's instructions for handling, storing, installation and finishing of treated material.

Preservative Treatment: For each type specified, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained and conformance with applicable standards.

For water-borne treatment include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to project site.

For fire-retardant-treatment include certification by treating plant that treated material complies with specified standards and other requirements.

PRODUCT HANDLING

Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

PROJECT CONDITIONS

Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow attachment of other work.

PART 2 - PRODUCTS

LUMBER, GENERAL

Lumber Standards: Manufacture lumber to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

Grade Stamps: Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing and mill.

Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

Provide dressed lumber, S4S, unless otherwise indicated.

Provide kiln-dried lumber with 15 percent (15%) maximum moisture content at time of dressing and shipment for sizes 2" or less in nominal thickness, unless otherwise indicated.

DIMENSION LUMBER

For light framing provide the following grade and species:

Construction grade, fir or yellow pine.

BOARDS

Exposed Boards: Where boards will be exposed in the finished work, provide the following:

Moisture content: 15 percent maximum, "MC-15"

Where transparent or natural finish or no finish is indicated, provide Redwood, Select Heart Grade (RIS).

Where painted finish is indicated, provide No. 1 Boards per SPIB rules, Select Merchantable Boards per WCLIB rules, or No. 2 Common Boards & Better per WWPA rules.

Concealed Boards: Where boards will be concealed by other work, provide lumber of 15 percent maximum moisture content and of following species and grade:

ROUGH CARPENTRY

Redwood Construction Common per RIS rules, Southern Pine No. 2 Boards per SPIB rules, or any species graded Construction Boards per WCLIB or WWPA rules.

Board Sizes: Provide sizes indicated and as required.

MISCELLANEOUS LUMBER

Provide wood for support or attachment of other work including curbs, support bases, bucks, nailers, blocking, furring, grounds, stripping and similar members. Provide lumber of sizes indicated, worked into shapes shown, and as follows:

Provide same grade and species as dimension lumber.

CONSTRUCTION PANELS

Construction Panel Standards: Comply with PS 1 "U.S. Product Standard for Construction and Industrial Plywood" for plywood panels and, for products not manufactured under PS 1 provisions, with American Plywood Association (APA) "Performance Standard and Policies for Structural-Use Panels."

Trademark: Factory-mark each construction panel with APA trademark evidencing compliance with grade requirements.

Miscellaneous Exposed Plywood: A-C, Group 1, Exterior, not less than 3/4-inch nominal.

Miscellaneous Concealed Plywood: C-C Plugged Exterior, not less than 3/4 inch nominal.

Provide preservative treated plywood at roof edges and parapets.

Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant treated plywood panels with grade designation, APA C-D PLUGGED EXPOSURE 1, in thickness indicated, or, if not otherwise indicated, not less than 15/32".

MISCELLANEOUS MATERIALS

Fasteners and Anchorages: Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide gears and framing anchors of the size and type recommended by the manufacturer for each use including recommended nails.

Where rough carpentry work is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A 153).

PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

ROUGH CARPENTRY

General: Where lumber or plywood is indicated as "Trt-Wd" or "Treated," or is specified herein to be treated, comply with applicable requirements of AWPB Standards C2 (Lumber) and C9 (Plywood) and of AWPB Standards listed below. Mark each treated item with the AWPB Quality Mark Requirements.

Pressure-treat with water-borne preservatives to comply with AWPB LP-2 with a minimum retention of 0.25 pcf. After treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent (19%) and 15 percent (15%). Treat indicated items and the following:

Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, and gravel stop, wood bucks at window jambs and similar locations in exterior walls, and wood members in contact with concrete.

Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces with heavy brush coat of same chemical used for treatment and to comply with AWPB M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS

General: Where fire-retardant-treated wood is indicated, pressure impregnate lumber and plywood with fire-retardant chemicals to comply with AWPB C20 and C27, respectively, for treatment type indicated; identify "fire-retardant-treated wood" with appropriate classification marking of Underwriters Laboratories, Inc., U.S. Testing, Timber Products Inspection, Inc., or other testing and inspecting agency acceptable to authorities having jurisdiction.

Interior Type A: For interior locations use fire-retardant chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:

No reduction takes place in bending strength, stiffness, and fastener holding capacities below values published by manufacturer of chemical formulation that are based on tests by a qualified independent testing laboratory of treated wood products identical to those indicated for this Project under elevated temperature and humidity conditions simulating installed conditions.

No other form of degradation occurs due to acid hydrolysis or other causes related to manufacture and treatment.

No corrosion of metal fasteners results from their contact with treated wood.

Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

All lumber and plywood used on the interior of the building for nailers, blocking, and furring of any nature shall be fire-retardant treated.

Products: Subject to compliance with requirements, provide one of the following:

Interior Type A Fire-Retardant-Treated Wood:

"Dricon," Hickson Corporation.

"Pyro-Guard," Hoover Treated Wood Products.

"Flameproof LHC-HTT," Osmose Wood Preserving Co., Inc.

PART 3 - EXECUTION

INSTALLATION, GENERAL

Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.

Set carpentry work to required levels and lines, with members plumb and true to line and cut and fitted.

Fit rough carpentry to other construction; scribe and cope as required for accurate fit.

Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards.

Countersink nail heads on exposed carpentry work and fill holes.

Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

WOOD GROUNDS, NAILERS, BLOCKING AND SLEEPERS

Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.

Comply with recommendations of National Forest Products Association (N.F.P.A.).

Anchor and nail as indicated and to comply with "National Design Specifications for Wood Construction" published by N.F.P.A.

END OF SECTION 06100

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SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This section includes the following:

- Laminate clad cabinets (plastic-covered casework).

- Cabinet tops (countertops) and interior window sills.

- Solid surfacing material for countertops and sinks.

Related Sections: The following sections contain requirements that relate to this section:

- Division 6 Section "Rough Carpentry" for furring, blocking, and other carpentry work that is not exposed to view.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product data for each type of product and process specified in this section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

Samples for initial selection purposes of the following in form of manufacturer's color charts consisting of actual units or sections of units showing full range of colors, textures, and patterns available for each type of material indicated.

- Plastic laminate.

- Solid surfacing materials.

Samples for verification purposes of the following:

- Laminate clad panel products, 8-1/2 inches by 11 inches for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.

- Solid surfacing materials, 6 inches square.

Product certificates signed by woodwork manufacturer certifying that products comply with specified requirements.

QUALITY ASSURANCE

Manufacturer Qualifications: Firm experienced in successfully producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

Single-Source Manufacturing and Installation Responsibility: Engage a qualified Manufacturer to assume undivided responsibility for woodwork specified in this section, including fabrication, finishing, and installation.

AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.

Hardware Coordination: Distribute copies of approved schedule for cabinet hardware specified in Division 8 Section "Finish Hardware" to manufacturer of architectural woodwork; coordinate cabinet shop drawings and fabrication with hardware requirements.

DELIVERY, STORAGE, AND HANDLING

Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.

Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

PROJECT CONDITIONS

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.

Field Measurements: 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

HIGH PRESSURE DECORATIVE LAMINATE MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide high pressure decorative laminates of one of the following:

Formica Corp.
Nevamar Corp.
Ralph Wilson Plastics Co. (Wilsonart)

MATERIALS

General: Provide materials that comply with requirements of the AWI woodworking standard for each type of woodwork and quality grade indicated and, where the following products are part of woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:

Hardboard: ANSI/AHA A135.4

High Pressure Laminate: NEMA LD 3.

Medium Density Fiberboard: ANSI A208.2.

Particleboard: ANSI A208.1.

Softwood Plywood: PS 1.

Formaldehyde Emission Levels: Comply with formaldehyde emission requirements of each voluntary standard referenced below:

Particleboard: NPA 8.

Medium Density Fiberboard: NPA 9.

Hardwood Plywood: HPMA FE.

Solid Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with the material and performance requirements of ANSI Z124.3, Type 5 or Type 6, without a precoated finish.

Products: Subject to compliance with requirements, provide one of the following:

Corian; DuPont Polymers.
Surell; Formica Corp.
Fountainhead; Nevamar Corp.
Gibraltar; Ralph Wilson Plastics Co.

FABRICATION, GENERAL

Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation

areas.

Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

Corners of cabinets and edges of solid wood (lumber) members less than 1 inch in nominal thickness: 1/16 inch.

Edges of rails and similar members more than 1 inch in nominal thickness: 1/8 inch.

Complete fabrication, including assembly, finishing, and hardware application, before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

Factory-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water-resistant coating.

LAMINATE CLAD CABINETS (PLASTIC-COVERED CASEWORK)

Quality Standard: Comply with AWI Section 400 and its Division 400B "Laminate Clad Cabinets."

Grade: Custom.

Laminate Cladding: High pressure decorative laminate complying with the following requirements:

Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

Provide selections made by Contracting Officer from laminate manufacturer's full range of colors and finishes in the following categories:

Solid Colors.

Patterns.

Laminate Grade for Exposed Surfaces: Provide laminate cladding complying with the following requirements for type of surface and grade.

Horizontal Surfaces Other Than Tops: GP-50 (0.050-inch nominal thickness).

Postformed Surfaces: PF-42 (0.042-inch nominal thickness).

Vertical Surfaces: GP-28 (0.028-inch nominal thickness).

Edges: PVC tape, 3 mm minimum thickness matching laminate in color, pattern and

finish.

Semiexposed Surfaces: Provide surface materials indicated below:

Woodwork manufacturer's standard low pressure laminate.

CABINET HARDWARE AND ACCESSORY MATERIALS

General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Finish Hardware."

Cabinet Hardware Schedule: Refer to schedule at end of this section for cabinet hardware required for architectural cabinets.

Hardware Standard: Comply with ANSI/BHMA A156.9 "American National Standard for Cabinet Hardware" for items indicated by reference to BHMA numbers or referenced to this standard.

Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA code number indicated.

Satin Chromium Plated, Brass or Bronze Base: BHMA 626.

For concealed hardware provide manufacturer's standard finish that complies with product class requirements of ANSI/BHMA A156.9.

ARCHITECTURAL CABINET TOPS (COUNTERTOPS) AND INTERIOR WINDOW SILLS

Quality Standard: Comply with AWI Section 400 and its Division 400C.

Type of Top: High pressure decorative laminate complying with the following:

Grade: Custom.

Laminate Cladding for Horizontal Surface: High pressure decorative laminate as follows:

Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

Provide selections made by Contracting Officer from manufacturer's full range of colors and finishes in the following categories:

Solid colors.

Patterns.

Grade: GP-50 (0.050-inch nominal thickness), except use PF-42 where required for post forming.

Edge Treatment: Same as laminate cladding on horizontal surfaces.

SOLID SURFACING MATERIAL COUNTERTOPS

Fabrication: Fabricate tops in one piece with shop-applied endsplashes, backsplashes, aprons, and edges, unless otherwise indicated. Comply with solid surfacing material manufacturer's recommendations for adhesives, sealers, fabrication, support and finishing.

Install undermount integral sink bowls in countertops in the shop. Minimum size shall be 16" x 13½" x 5½" deep.

Drill holes in countertops for plumbing fittings in the shop.

Intermediate Braces: As required for support and to match top.

Solid Surfacing Material Thickness: 3/4 inch.

Edge Treatment: Angled no-drip edge.

Color, Patterns, and Finishes: Provide materials and products that result in colors of solid surface material complying with the following requirements:

Provide Architect's selections from manufacturer's full range of colors and finishes.

FASTENERS AND ANCHORS

Screws: Select material, type, size and finish required for each use. Comply with FS FF-S-111 for applicable requirements.

For metal framing supports, provide screws as recommended by metal framing manufacturer.

Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.

Anchors: Select material, type, size, and finish required by each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

PART 3 - EXECUTION

PREPARATION

Condition woodwork to average prevailing humidity conditions in installation areas before installing.

Deliver inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.

Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

INSTALLATION

Quality Standard: Install woodwork to comply with AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.

Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 8'0" for plumb and level (including tops) and with no variations in flushness of adjoining surfaces.

Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

Where trim is not shown, but reasonably implied or required, it shall conform to trim shown or detailed.

All surfaces shall be checked prior to installation. Unsuitable or defective wood shall be replaced and all surfaces corrected before proceeding.

Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.

Complete the installation of hardware and accessory items as indicated.

Tops: Anchor securely to base units and other support systems as indicated.

ADJUSTMENT AND CLEANING

Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance. Clean, lubricate and adjust hardware.

Clean woodwork on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

PROTECTION

Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensures that woodwork is being without damage or deterioration at time of Substantial Completion.

HARDWARE SCHEDULE:

CLOSET AND UTILITY SHELVING HARDWARE:

Adjustable Shelf Standards and Related Supports: Provide standards and supports of type indicated which comply with ANSI/BHMA A156.9.

Horizontal Slotted Type: Surface or mortise mounted, 5/8" wide x 3/16" high x length indicated, BHMA No. B84071, nickel-plated steel. (Equal to "Knap & Vogt" #255 NP).

Support Type: Closed shelf rest, BHMA No. B84081, nickel-plated steel. (Equal to "Knap & Vogt" #256 NP, except use Knap & Vogt #256R at glass shelving.)

Vertical Slotted Type: Vertical slots spaced 2" on Center, 7/8" wide x 11/16" high x length indicated, BHMA No. B84102, Anochrome finish steel. Equal to "Knap & Vogt" #87 ANO).

Shelf Brackets: Size required to support shelving widths indicated, BHMA No. B84112., Anochrome finish steel. (Equal to "Knap & Vogt" #187 and with "Knap & Vogt" #211 shelf rests).

CABINET HARDWARE:

Drawers (Each to have):

1 pr. Drawer Slides 6020 x length as required (GRASS)
1 Pull 4484-US26D (STANLEY)

3/4" Thick Doors (Each to have):

1 pr. Hinges 3606 with necessary mounting plates for 95 degree opening angle (GRASS)
(Note: Provide 1-1/2 pair at doors 40" high or more.)
1 Pull 4484 - US26D (STANLEY)

Miscellaneous Items:

Cabinet Locks 15891 x 26D - cam as required (CORBIN). See drawings for locations.

Elbow Catch - 2 x MB26D (IVES). Furnish one with each pair of cabinet doors with one door leaf having a cabinet lock.

END OF SECTION 06402

SECTION 06410 - CABINETWORK - PLASTIC LAMINATE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Conditions of the Contract and Division 1 apply to this Section.
- B. Provide labor, materials and equipment to complete plastic laminate cabinetwork as indicated in the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 06100 - Rough and Finish Carpentry
- B. Division 15 - Sinks and Sink Rims

1.3 QUALITY ASSURANCE

- A. Plastic laminate work shall conform to design, quality of materials, workmanship, and function as specified and shown on plans. Comply with referenced AWI Standards - latest edition, except as modified in these specifications.
- B. Cabinetwork Fabricator shall be a full or associated member of AWI and shall have been in business a minimum of (5) five consecutive years producing specified items.
- C. Fabricate only from approved shop drawings.
- D. Coordinate all layout and dimensions with work in place and other trades whose products will be installed within or adjacent to the cabinetwork.
- E. Reference Standards
 - 1. ASTM American Society for Testing and Materials
 - 2. AWI Architectural Woodworking Institute

1.4 SUBMITTALS

- A. Refer to Section 01300 for Submittal Requirements.
- B. Shop Drawings: Submit shop drawings showing layout and dimensions. Locate all materials, fittings, and accessories. Include fastenings and joinery. Tag all loose pieces for field installation.
- C. Samples
 - 1. Two 2" x 3" samples of plastic laminate color and type.
 - 2. Cabinet Hardware: One sample of each hardware item.
- D. Manufacturer's Literature: All panel products, laminate and hardware.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver plastic laminate items only when project is ready for immediate installation. Do not store in building for future installation.
- B. Protect plastic laminate work during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration. Protect work until completion of work.
- C. Do not deliver plastic laminate work until painting, wet work, and similar operations which could damage woodwork have been completed.
- D. In event of damage, immediately make all repairs and replacement necessary for approval of Contracting Officer at no additional cost to Government.

1.6 ENVIRONMENTAL CONDITIONS

- A. Assure permanent heating/cooling system is in operation and building spaces are maintained at 55°F to 75°F with relative humidity 30% to 60%. Temperature and humidity shall be stabilized.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Construction Grade Standards
 - 1. Plastic laminate cabinet work, shelving, tops, etc.: Custom.
- B. Panel Products
 - 1. Prefinished Melamine Surfaced Panels:
 - a. Kortron/EB as manufactured by Williamette Industries, Inc. or MCP as manufactured by Masonite Corporation.
 - 1. Surfaced one or two sides as required.
 - 2. Colors to be selected later.
 - b. Plumb Creek Prefinished Fiberboard.
 - 2. Hardboard: Masonite, Georgia-Pacific or equal hardboard.
- C. Plastic Laminate Materials:
 - 1. Plastic Laminate Backing
 - a. Particle board, minimum 45# density, Williamette Industries or equal.
 - 2. Plastic Laminate: Plastic laminate manufacturer and color selection as indicated on the Architectural Finish List.

- a. Tops and Horizontal - Grade 50.
- b. Vertical - Grade 28.
- c. Semi-concealed - Cabinet Liner Grade 72.
- d. Concealed - Backing Sheet Grade 91 or 92.

D. Solid Sheet Plastic

1. Gibraltar, as manufactured by Wilsonart Co. Solid homogenous thermoset polymer of polyester and acrylic compounds with fillers. Similar products of Nevamar and Dupont may be used provided they can match the color to the approval of the Contracting Officer.
2. Size, shape, configuration and thickness as shown on drawings for tops, backsplash, side splash, supports and edge material.
 - a. Provide integral bowl at vanity.
3. Colors: See Architectural Finishes List.
4. Adhesives: Provide materials as recommended by manufacturer.
5. Sealants: Provide materials as recommended by manufacturer.
6. Color Inlay: Provide materials as recommended by manufacturer.

E. Acrylic Sheet Material

1. Cyro Co. Acrylite AR or AtoHaas "Plexiglass" type "MR" (Mar resistant), clear Acrylic sheet plastic, 1/8" thick.

F. Adhesives and Fasteners

1. Laminating Adhesives: As recommended by panel or plastic laminate manufacturer for substrata application.
2. Fabrication Adhesives: Fabricator's option for specific application.
3. Fasteners: As required and recommended by fabricator and installer.
 - a. Use Type W Hi-Low screws for joining cabinetwork sections or concealed members in field.
 - b. Use concealed fasteners at all joints in tops.

G. Hardware

1. Pulls: Loop style EPCO MC4024 - Finish: 626 Satin Chrome.

2. Shelf Supports: EPCO Co. Series 520 "spoon" shaped plated steel with shelf fixing lug.
 3. Hinges
 - a. Blum "Module" concealed casework hinges, 180° opening or to suit conditions. Stanley concealed casework hinges are acceptable.
 - b. SOSS Company concealed cabinet hinge, size and quantity as recommended by the SOSS Company for countertop raceway lid to support cabinet doors.
 4. Slides
 - a. Drawer: Blum BS 420E full extension, 100 lbs./pair rated or K & V 1400 Series full extension, 100 lbs./pair rated.
 5. Miscellaneous
 - a. Door and Drawer Bumpers: Blum SJ5312 or equal.
 6. Locks
 - a. Best Lock Company 5L Series, rim type, 5 barrel core, 5 pin cylinder. Finish: 626
 7. Grommets: minimum 1-1/2" dia. black plastic grommets with spring loaded door or iris for feeding CRT cable thru tops.
 8. Sliding panel tracks and guides: EPCO Co. 700 series, No. 710-1 assembly, Clear anodized finish.
 9. Card Holder: Brookline 3460, Aluminum.
- H. Keyboard Drawer
1. Moulded plastic keyboard drawer for under desk mounting. Full extension ball bearing slides each end.
 - a. 24"w x 16"d x 2"h
 - b. Finish: Integral beige or grey color
- I. Miscellaneous
1. Miscellaneous fastening devices and materials as required for fabrication or securing components in place or to adjoining construction as recommended by fabricator and installer and to suit job conditions.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Deliver cabinets, tops and shelving to job in single piece as much as possible.

- B. Carefully wrap and protect all finished items including cabinets, tops, shelves and doors, from damage.
- C. Tag all pieces with same tags and nomenclature as on approved shop drawings. Tags shall occur on backs or concealed places.
- D. Deliver to job in coordination with finish carpenter.
- E. Inspect work installed by others and coordinate with carpentry contractor to assure all required wood blocking has been properly installed and with drywaller as required.

3.2 INSTALLATION

A. General

- 1. Fabricate in strict compliance with specified AWI grade standards for each product type.
- 2. Shop fabricate in strict compliance with approved shop drawings.
 - a. Field verify all dimensions prior to fabrication.
 - b. Fabricate into one piece units as much as possible. Use no splices unless approved in shop drawings or in writing by Contracting Officer.
- 3. Take field dimensions prior to preparing shop drawings. Check adjacent surfaces for plumb and squareness.
- 4. Coordinate all necessary cut-outs with mechanical, electrical, and other involved trades.
- 5. Apply all hardware per manufacturer's printed instructions.
- 6. All plastic laminate shall have plastic laminate backing and edging or backer sheets for concealed surfaces.

B. Plastic Laminate Cabinetwork

- 1. Exposed and semi-concealed surfaces and exposed shelves shall be laminated and all surfaces and edges banded where exposed to view.
 - a. Interior cabinet surfaces except door backs may be Kor-Tron. Door backs shall be faced and edged with plastic laminate.
 - b. Cabinetwork shelves may be Kor-Tron with edging.
- 2. Provide balance sheet of plastic laminate on back of all exposed and semi-concealed plastic laminate surfaces.
- 3. Edges of doors and drawers shall be banded with plastic laminate to match specified face color.

4. Install all specified hardware: Hardware distribution as shown on drawings.
- C. Tops and Shelving: Construct to profiles and configurations shown on the drawings using particle board with plastic laminate face and backer sheets.
1. Allow room and sufficient material to scribe top to wall. Joints shall be "invisible" and fastened with concealed joint fasteners. Joints not allowed in tops 12'-0" or less in length except in corners.
 2. Provide finish edges at all exposed surfaces including backsplash and returns.
 3. Fasten to cabinet body with concealed fasteners. Fasten vanity tops and work surfaces to wall with plastic laminate supports.
 4. Provide drop edge at all shelving where applicable.
 5. Adjust cabinetwork as required to set plumb level.
 6. Scribe to adjacent surfaces without gap.
 7. Blind fasten to adjacent surfaces as much as possible. All fastening concealed from view.
- D. Solid Plastic Lavatory/Vanity Tops
1. Fabricate from specified homogenous plastic to profiles shown on drawings. Install lavatory bowl to be integral with vanity top.
 2. Fabricate in strict accordance with manufacturer's instructions using only recommended tools, methods, adhesives, sealants, etc.

3.3 ADJUST AND CLEAN

- A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware. Replace hardware that has been damaged.
- C. Clean woodwork on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.
- D. Turn keys over to Government.
- E. Clean premises of all litter, dirt and debris created by work of this Section. Leave premises broom clean.

END OF SECTION 06410

SECTION 07110 - SHEET MEMBRANE WATERPROOFING

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes sheet membrane waterproofing systems.

Types of sheet waterproofing specified in this Section include the following:

Rubberized asphalt sheet waterproofing. Apply to exterior vertical surfaces as indicated on drawings.

SYSTEM PERFORMANCE

General: Provide sheet waterproofing products that have been produced and installed to establish and maintain continuous watertight seals.

SUBMITTALS

Product data and general recommendations from waterproofing materials manufacturer.

QUALITY ASSURANCE

Manufacturer's Qualifications: Obtain primary waterproofing materials of each type required from a single manufacturer to the greatest extent possible. Provide secondary materials only as recommended by manufacturer of primary materials.

Installer: A firm with not less than five waterproofing projects similar to requirements for this Project with satisfactory in-service performance and which is approved by primary waterproofing materials manufacturer.

PROJECT CONDITIONS

Substrate: Proceed with work after substrate construction, openings, and penetrating work have been completed and areas are free of standing or running water, ice, and frost. Verify that concrete is dry, smooth, and free from sharp or ragged out-angles, honeycombing, rock pockets, depressions, and projections.

Weather: Proceed with waterproofing and associated work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.

WARRANTY

Warranty: Submit a written warranty executed by the manufacturer, agreeing to repair or replace sheet membrane waterproofing that fails in materials or workmanship within specified warranty period.

Warranty Period: Five years from date of Substantial Completion.

The warranty shall not deprive the Government of other rights the Government may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

RUBBERIZED ASPHALT SHEET WATERPROOFING

Rubberized asphalt self-adhering membrane integrally bonded to polyethylene sheeting, formed into uniform flexible sheets of not less than 56 mils thick, complying with the following:

Tensile Strength: 250 psi minimum; ASTM D 412.

Ultimate Elongation: 300 percent minimum; ASTM D 412.

Brittleness Temperature: Minus 25 deg F (minus 32 deg C); ASTM D 746.

Hydrostatic Head Resistance: 150 feet minimum.

Water Absorption: Not more than 0.5 percent weight gain after 48 hours' immersion at 70 deg F (21 deg C); ASTM D 570.

Products: Subject to compliance with requirements, provide one of the following:

Bituthene, W.R. Grace & Co.

MEL-ROL, W.R. Meadows, Inc.

AUXILIARY MATERIALS

Adhesives and Joint Tape: Provide types of adhesive compound and tapes recommended by waterproofing sheet manufacturer for bonding to substrate, for waterproofing seams in membrane, and for waterproofing joints between membrane and flashings, adjoining surfaces, and projections through membrane.

Primers: Provide type of concrete primer recommended by manufacturer of sheet waterproofing material for applications required.

Flashing Materials: Except as otherwise indicated, provide types of flexible sheet material for flashing as recommended by waterproofing sheet manufacturer.

Continuous Termination Bar: Provide continuous termination bar at top of membrane as indicated and as recommended by manufacturer.

Fasten to wall per manufacturer's recommendations.

Top Edge Seal: For vertical membrane, finish in reglet and provide continuous termination bar.

Caulk exposed edges with mastic or sealant.

Coat exposed areas of sheet and flashing materials to comply with sheet manufacturer's recommendations.

Protection Board: Provide type of protection board recommended by waterproofing sheet manufacturer for vertical surfaces. Include adhesives recommended by manufacturer.

PART 3 - EXECUTION

PREPARATION

General: Comply with manufacturer's instructions for preparing surface.

On vertical walls chip off projections where necessary to properly place and adhere waterproofing sheet.

Apply primer to substrate surfaces at rate recommended by manufacturer of primary waterproofing materials. Prime only area that will be covered by waterproofing membrane in same working day. Reprime areas not covered by waterproofing membrane within 24 hours.

INSTALLATION

Comply with manufacturer's instructions for handling and installing sheet waterproofing materials.

Coordinate installing waterproofing materials with associated work to provide complete system complying with combined recommendations by manufacturers and installers involved in Work. Schedule installation to minimize exposure of sheet waterproofing materials.

Extend waterproofing sheet and flashings to provide a complete membrane over area indicated to be waterproofed.

Comply with recommendations of manufacturer to seal and flash membrane terminations.

Seal projections through membrane and seal seams. Bond to vertical surfaces and also, where shown or recommended by manufacturer, bond to horizontal surfaces.

Protection Board: Install protection board over completed membrane, complying with manufacturer's recommendations for both waterproofing sheet and protection course materials.

CLEANING

General: After completion, remove any masking materials and stains from exposed surfaces caused by waterproofing installation.

PROTECTION

General: Protect completed membrane during installation of other materials or processes over membrane and throughout remainder of construction period. Do not allow traffic of any type on unprotected membrane.

END OF SECTION 07110

SECTION 07210 - BUILDING INSULATION

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

Safing insulation.

Perimeter foundation insulation.

Building insulation in batt form.

Air vapor barrier.

Related Sections: The following sections contain requirements that relate to this section:

Division 4 Section "Unit Masonry" for polystyrene board insulation installed in cavity walls and masonry cells.

Division 7 Roofing Sections indicated below for roof insulation specified as part of roofing construction:

“Single Ply Membrane Roofing.”

“Manufactured Roof Panels.”

Division 9 Section indicated below for sound attenuation insulation installed as part of metal-framed wall and partition assemblies:

“Gypsum Board Assemblies.”

DEFINITIONS

Thermal Resistivity: Where the thermal resistivity of insulation products are designated by "r-values," they represent the reciprocal of thermal conductivity (k-values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product data for each type of insulation product specified.

QUALITY ASSURANCE

Fire Performance Characteristics: Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per the ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.

Surface Burning Characteristic: ASTM E 84.

Fire Resistance Ratings: ASTM E 119.

Combustion Characteristics: ASTM E 136.

Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

DELIVERY, STORAGE, AND HANDLING

Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide insulation products of one of the following:

Manufacturers of Extruded Polystyrene Board Insulation:

Amoco Foam Products Co.
DiversiFoam Products.
UC Industries, Inc.

Manufacturers of Glass Fiber Insulation:

CertainTeed Corp.

Manville: Building Insulations Div.,
Manville Sales Corp.
Owens/Corning Fiberglass Corp.

Manufacturers of Safing Insulation:

USG: Thermafiber Div., USG Interiors, Inc.

INSULATING MATERIALS

General: Provide insulating materials that comply with requirements and with referenced standards.

Preformed Units: Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

Unfaced Mineral Fiber Blanket/Batt Insulation: Thermal insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing); and as follows:

Mineral Fiber Type: Fibers manufactured from glass or slag.

Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50, respectively.

Extruded Polystyrene Board Insulation: Rigid, cellular thermal, insulation with closed-cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578 for Type indicated; with 5-year degrees aged r-values of 5.4 and 5 at 40 and 75 degrees F (4.4 and 23.9 degrees C), respectively; and as follows:

Type IV, 1.6 pounds/cubic foot minimum density, unless otherwise indicated.

AIR VAPOR BARRIER

General: Reinforced, 3-ply high-density polyethylene sheets equal to Griffolyn, Type-65. Seal joints and edges of vapor barrier as recommended by manufacturer.

SAFING INSULATION AND ACCESSORIES

Safing Insulation: Thickness as required, unfaced.

Calking Compound: Material approved by manufacturer of safing insulation for sealing joint between safing insulation and edge of concrete floor slab against penetration of smoke.

Safing Clips: Galvanized steel safing clips approved by manufacturer of safing insulation for holding safing insulation in place.

AUXILIARY INSULATING MATERIALS

Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation or mechanical anchors securely to substrates indicated without damaging or corroding either insulation, anchors, or substrates.

Mechanical Anchors: Type and size as recommended by insulation manufacturer.

PART 3 - EXECUTION

EXAMINATION

Examine substrates and conditions with Installer present, for compliance with requirements of the Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

PREPARATION

Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections that might puncture vapor retarders.

INSTALLATION, GENERAL

Comply with insulation manufacturer's instructions applicable to products and application indicated. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with installation of insulation.

Extend insulation full thickness as indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement.

Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

INSTALLATION OF PERIMETER INSULATION

On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions. Use type of adhesive recommended by manufacturer of insulation.

Protect insulation on vertical surfaces (from damage during backfilling). Install perimeter insulation on inside surface of exterior foundation wall, minimum 24" wide.

INSTALLATION OF GENERAL BUILDING INSULATION

Apply insulation units to substrate, complying with manufacturer's recommendations. Bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

Seal joints between insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

Stuff glass fiber loose fill insulation into miscellaneous voids and cavity spaces. Compact to approximately 40 percent of normal maximum volume (to a density of approximately 2.5 pcf).

INSTALLATION OF SAFING INSULATION

Install safing insulation to fill openings and gaps in fire-rated ceilings, floors and walls. Leave no voids in completed installation.

PROTECTION

General: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07210

SECTION 07240 - EXTERIOR INSULATION AND FINISH SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Conditions of the Contract and Division 1 apply to this Section.
- B. Provide labor, materials, and equipment to complete exterior insulation and finish system work as indicated in the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 - Concrete
- B. Section 04200 - Masonry
- C. Section 06100 - Rough and Finish Carpentry
- D. Section 07920 - Sealants and Caulking

1.3 QUALITY ASSURANCE

- A. Applicator shall be currently approved/certified by Exterior Insulation and Finish System manufacturer.
- B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- C. Reference Standards
 - 1. ASTM E84 Test for Surface Burning Characteristics of Building Materials
 - a. Flame Spread Index: 5
 - b. Smoke Development Value: 25
 - c. Class 1
 - 2. ASTM E108, Full Scale Diversified Fire Test Modified for Vertical Walls
 - a. Result: The system shall not contribute to significant vertical or horizontal flame spread. Finish shall prevent fire involvement of the insulation core. No fall-off coating.
 - 3. ASTM E 33 Wind Resistance
 - 4. FS TT-C-555 Wind Driven Rain

5. ASTM 623, Method 1 or ASTM 626 Accelerated Weathering
6. MIL Standard 810, Method 508 Mildew Resistance
7. EIMA Test Method Standard 101.86 Impact Resistance

1.4 SUBMITTALS

- A. Refer to Section 01300 for Submittal Requirements.
- B. Product Data: Descriptive literature with technical data indicating materials, tests, installation and storage instructions, and specifications.
- C. Shop Drawings: Details of mechanical attachment system including spacing of fasteners. Details of each edge and joint condition, including adjacent construction.
- D. Samples: 8" x 8" panel of insulation and exterior finish system showing all layers, insulation board, fasteners, accessories, colors, and texture.
- E. Warranty
- F. Certificates
 1. Applicator Certification by manufacturer.
 2. Specification and details showing conformance to manufacturer's recommendations.
- G. Test Reports: Independent laboratory reports or certificates demonstrating compliance with design requirements.
- H. Mock-Up
 1. Prior to the installation of system erect mock-ups of each form of wall construction and finish required in order to verify selections made under sample submittals and to demonstrate aesthetic effects and compliance with execution requirements.
 2. Erect mock-ups in presence of the Architect/Engineer. Demonstrate proposed range of color, texture, and workmanship. Obtain the Architect/Engineer's acceptance of mock-ups before start of permanent work.
 3. Retain and maintain mock-ups during construction for judging completed work. When directed, demolish mock-ups and remove from project site.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in unopened, undamaged containers, clearly marked and identified with name and description of contents.
- B. Store all products supplied in a cool, dry place of direct sunlight, protected from weather, moisture and other damage. Store all wet materials at a temperature not less than 32°F at all times. Store

insulation board away from open flame.

1.6 ENVIRONMENTAL CONDITIONS

- A. The ambient air temperature shall be a minimum of 40°F or greater and rising at the time of installation of the coatings system and shall remain at 40°F for at least 24 hours after application.

1.7 WARRANTY

- A. Manufacturer shall provide a five year limited warranty that all materials are guaranteed to be as specified and free from defects for a period of five years from the date of installation.
- B. Installer shall guarantee all work of this section for a period of one year from the date of final acceptance.
 - 1. Guarantee shall include uniformity of color.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. EIFS System Description: The (EIFS) exterior insulation and finish system shall be the Insul/Crete Gold System as manufactured by Parex. The system shall consist of:
 - 1. Extruded polystyrene insulation board.
 - 2. Glass fabric reinforcing mesh.
 - 3. Plastic coated mechanical anchors.
 - 4. Base Coat: Acrylic Modified Portland Cement consistency of I-C gold liquid and dry mix.
 - 5. Primer: Acrylic Copolymer
 - 6. Finish Coat: Factory mixed, integrally coated synthetic finish.
 - a. Finish coat shall have one (1) custom color selected by Government.
 - b. Fine "sand" textured surface.
 - 7. Sealant at system joints.
 - 8. Reveal joint grooves shall be routed into insulation.
 - 9. Square edge tracks.
 - 10. Seal Tape: Polyester - polyurethane expanding foam sealant tape.
- B. EIFS System Materials
 - 1. Extruded Polystyrene Insulation Boards:

- a. Shall meet ASTM specification C578 Type IV.
 - b. Nominal density specification ASTM C578 Type IV.
 - c. Compressive strength 215 PSI (ASTM C 1621-73).
 - d. Thickness as shown on the drawings.
2. Standard Reinforcing Fabric: Shall be balanced open weave glass fiber fabric.
- a. Weight: 4.60 oz./sq. yd.
 - b. Thickness: .018 inches
 - c. Coated for alkali resistance
 - d. Count: 5 x 5 ends/inc
3. Intermediate Reinforcing Fabric: Shall be balanced open weave glass fiber fabric.
- a. Weight: 12 oz./sq. yd.
 - b. Thickness: .028 inches
 - c. Coated for alkali resistance
 - d. Tensile strength: Warp: 350 lb./inch
 Fill: 500 lb./inch
4. Corner Reinforcing Fabric: Heavy duty, fiberglass, pre-folded reinforcement fabric.
- a. Weight: 7.2 oz./sq. yd.
 - b. Thickness: .026 inches
 - c. Coated for alkali resistance
 - d. Count: 4.8 x 3.5/inch
 - e. Tensile strength: Warp: 308 lb./inch
 Fill: 274 lb./inch
5. Detail Reinforcing Fabric: Shall be balanced open weave glass fiber fabric.
- a. Weight: 4.5 oz./sq. yd.
 - b. Thickness: .135 inches
 - c. Coated for alkali resistance
 - d. Count: 12 x 6/inch

- e. Tensile strength: Warp: 150 lb./inch
Fill: 150 lb./inch
- 6. Expansion Fasteners: Concrete and masonry substrates - expandable sheath with corrosion resistant hammer driven pin, pre-drilled and used with manufacturer's washer attachment. Anchor spacing not to exceed 12" vertically and 16" horizontally with minimum penetration of 1".- Fastener sheath and caps shall be plastic or nylon type with steel pin.
- 7. Insul/Crete Washer with Corrosion Resistant Screw: Metal/wood substrates - Type "S" fasteners for steel framing. Type "W" fasteners for wood frames.
- 8. Base Coat: Shall be polymer modified portland consisting of I-C gold liquid and I-C gold dry mix as supplied by the manufacturer.
- 9. Primer: Shall be copolymer acrylic liquid as supplied by system manufacturer. Tinted to the color of the finish coating. Titanium dioxide pigment base.
- 10. Finish Coat:
 - a. Synthetic shall be factory blended and integrally colored synthetic finish as supplied by manufacturer.
- 11. Accessories: Square edge tracks and seal tape as recommended by manufacturer.

C. Miscellaneous Materials

- 1. Sealant: Shall be ultralow modulus or silicone capable of 100% elongation and 50% compression. Polyurethane sealants shall conform to ASTM C 920-87 Type M, grade NS and TT-S-00227E, Type II. Silicone sealant shall conform to TT-S-1543 A, Type II.
 - a. Acceptable Manufacturers: Tremco Dymeric Plus Epoxidized Polyurethane Sealant. Dow Corning Silicone Building Sealant.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The substrate shall be examined for soundness, such as tightness of connections, crumbling or looseness of surface projections, etc.
- B. The Architect/Engineer and General Contractor shall be advised of all discrepancies. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Protection of Other Work
 - 1. Provide tarpaulins, plastic sheeting, drop cloths, or other items in areas where exterior finishing is being done to protect doors, windows, masonry, metals, trees shrubs, paving,

and other work from damage.

2. When spraying, properly protect finished adjacent surfaces and other items from overspray or fall out. Mask surfaces required to receive other finishes.
3. Protect installed system from water infiltration behind system.

B. Finish System Installation

1. Installation shall conform to manufacturer's printed recommendations except as otherwise specified herein or as shown on the drawing.
2. Place horizontal reveals in locations shown on the drawings.
3. Base coat shall "wrap around" edges of panels and at joints.
4. Primer Installation:
 - a. Shall be tinted to the color of the finish coat.
 - b. Apply with roller, brush, or suitable spray equipment over the dry base coat.
 - c. Primer must be completely dry prior to application of finish coat.
5. Finish Installation:
 - a. Using a stainless steel trowel apply the finish to the fully cured and primed base coat.
 - b. The finish coat shall be applied and leveled to the minimum required thickness in the same application.
 - c. The finish coat shall be textured continually over the wall surface to maintain a wet edge, as per the manufacturers recommendations.
6. Provide square edge track as shown on the drawings.

C. Sealant: Installation

1. Install sealants only per approved shop drawings and manufacturer's printed instructions.
2. Install using specified back-up only. Prime surfaces if required.

3.3 ADJUST AND CLEAN

- A. Damage to Other Work: Make good damage to all work or items not to receive this finish, walls, wood finish, exterior stone, through neglect or carelessness of system installer or from failure to properly protect work. Replace items or materials, which are damaged to such an extent that they cannot be restored to their original condition.
- B. Repair and replace all damaged installation and finishes.

- C. Clean adjacent materials and surfaces of foreign materials resulting from the work of this Section.
- D. Clean-up premises of all litter, dirt and debris created by work of this Section.

END OF SECTION 07420

SECTION 07270 - FIRESTOPPING

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes firestopping for the following:

Penetrations through fire-resistance-rated walls and partitions including openings containing cables, pipes, ducts, conduits, and other penetrating items.

Sealant joints in fire-resistance-rated construction.

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

Division 7 Section "Building Insulation" for safing insulation and accessories.

Division 7 Section "Joint Sealants" for non-fire-resistive-rated joint sealants.

Division 15 Sections specifying ducts and piping penetrations.

Division 16 Sections specifying cable and conduit penetrations.

SYSTEM PERFORMANCE REQUIREMENTS

General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.

F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.

T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where required by code and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assemblies are required where the following conditions exist:

Where firestop systems protect penetrations located outside of wall cavities.

Where firestop systems protect penetrations located outside fire-resistive shaft enclosures.

Where firestop systems protect penetrations located in construction containing doors required to have a temperature-rise rating.

Where firestop systems protect penetrating items larger than a 4-inch-diameter nominal pipe or 16 sq. in. in overall cross-sectional area.

Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings as determined per ASTM E 119, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.

For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.

For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.

For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

For firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E 84.

SUBMITTALS

General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

Product data for each type of product specified.

Certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.

Shop drawings detailing materials, installation methods, and relationships to adjoining construction for each through-penetration firestop system, and each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.

Submit documentation, including illustrations, from a qualified testing and inspecting agency that

is applicable to each through-penetration firestop configuration for construction and penetrating items.

QUALITY ASSURANCE

Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the "System Performance Requirements" article:

Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.

Through-penetration firestop systems are identical to those tested per ASTM E 814 under conditions where positive furnace pressure differential of at least 0.01 inch of water is maintained at a distance of 0.78 inch below the fill materials surrounding the penetrating items in the test assembly. Provide rated systems complying with the following requirements:

Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in their "Fire Resistance Directory," by Warnock Hersey, or by another qualified testing and inspecting agency.

Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E 119 under conditions where the positive furnace pressure differential is at least 0.01 inch of water, as measured 0.78 inch from the face exposed to furnace fire. Provide systems complying with the following requirements:

Fire-Resistance Ratings of Joint Sealants: As indicated by reference to design designations listed by UL in their "Fire Resistance Directory" or by another qualified testing and inspecting agency.

Joint sealants, including backing materials, bear classification marking of qualified testing and inspection agency.

Single-Source Responsibility: Obtain through-penetration firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.

Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed per specified requirements.

DELIVERY, STORAGE, AND HANDLING

Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

PROJECT CONDITIONS

Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

Ventilation: Ventilate firestopping per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

PART 2 - PRODUCTS

FIRESTOPPING, GENERAL

Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.

Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with "System Performance Requirements" article in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems.

Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

FIRE-RESISTIVE ELASTOMERIC JOINT SEALANTS

Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses, and requirements specified in this Section applicable to fire-resistive joint sealants.

Sealant Colors: Provide color of exposed joint sealants to comply with the following:

Provide selections made by Contracting Officer from manufacturer's full range of standard colors

for products of type indicated.

Multicomponent, Nonsag, Urethane Sealant: Type M; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, A, and (as applicable to joint substrates indicated) O.

Products: Subject to compliance with requirements, provide one of the following:

Multicomponent, Nonsag, Urethane Sealant:

Dynflex, Pecora Corp.
Dynatred, Pecora Corp.
Dynatrol II, Pecora Corp.
Sonolastic NP 2, Sonneborn Building Products Div.
ChemRex Inc.
Dymeric, Tremco Inc.

FIRE-RESISTANT JOINT SEALERS

General: Provide manufacturer's standard fire-stopping sealant, with accessory materials, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

Foamed-In-Place Fire-Stopping Sealant: Two-part, foamed-in-place, silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around cables, conduit, pipes and similar penetrations through walls.

Products: Subject to compliance with requirements, provide one of the following:

Foamed-In-Place Fire-Stopping Sealant:

"Dow Corning Fire Stop Foam"; Dow Corning Corp.
"Pensil 851"; General Electric Co.

One-Part Fire-Stopping Sealant:

"3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M
"RTV 7403"; General Electric Co.
"Fyre Putty"; Standard Oil Engineered Materials Co.

MIXING

For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping

products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

EXAMINATION

Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

PREPARATION

Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:

Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.

Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.

Remove laitance and form release agents from concrete.

Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

INSTALLING THROUGH-PENETRATION FIRESTOPS

General: Comply with the "System Performance Requirements" article in Part 1 and the through-penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:

Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

INSTALLING FIRE-RESISTIVE JOINT SEALANTS

General: Comply with the "System Performance Requirements" article in Part 1, with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.

Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.

Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.

Tool nonsag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

CLEANING

Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.

Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

END OF SECTION 07270

FIRESTOPPING

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SECTION 07310 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Conditions of the Contract and Division 1 apply to this Section.
- B. Provide labor, materials, and equipment to complete shingles and associated underlayment and flashing as indicated in the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. All documents listed in Table of Contents are a condition of this Section.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations.
- B. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for 3 years.
- C. Use experienced installers.
- D. Reference Standards
 - 1. HUD - Housing and Urban Development
 - 2. ICBO - International Conference of Building Officials
 - 3. ASTM - American Society for Testing and Materials
 - 4. FM - Factory Mutual
 - 5. UL - Underwriters Laboratories
 - 6. NRCA - National Roofing Contractors Association

1.4 SUBMITTALS

- A. Refer to Section 01300 for Submittals Requirements.
- B. Product Data: Manufacturer's descriptive literature for each product specified, with technical data indicating materials, tests, installation, and storage instructions.
- C. Samples: Representative samples of each product specified, in colors selected by Architect.
- D. Extra Stock: Shingles to cover minimum 1 square (100 SF), in original packaging.

1.5 PRODUCT, DELIVERY, HANDLING, AND STORAGE

- A. Deliver, handle and store materials in accordance with manufacturer's instructions and good practice to prevent deformation, breakage, discoloration and other damage.

1.6 WARRANTY

- A. A forty (40) year architectural shingle written warranty from the manufacturer.
- B. A ten (10) year weather tightness written warranty from the installer.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Eave Ice Dam Protection: Minimum 40 mil thick self-adhering membrane of rubberized asphalt (minimum 250 psi tensile strength per ASTM D412 modified; minimum 250% elongation ultimate failure per ASTM D412 modified; pliability meeting ASTM D146) integrally bonded to polyethylene sheeting, meeting HUD material release 1056b and ICBO Report No. 3997.
- B. Vented Nail-Base Polyisocyanurate Insulation: Rigid, cellular thermal insulation with 1.5 pcf density, 16 psi minimum compressive strength, medium glass facer bonded to 7/16" OSB board with 3/4" air space between OSB and insulation.
- C. Underlayment: Asphalt impregnated 30 pounds per square unperforated rolled roofing felt.
- D. Valley Flashing: Minimum 28 gauge x 24 inch wide galvanized steel.
- E. Shingle/Step Flashing: Minimum 7" x 7" galvanized steel, bent.
- F. Roof Edge: Galvanized steel with double-back projection at top surface.
- G. Plastic Roofing Cement: Trowel grade asphaltic plastic cement meeting ASTM D-4586, Type II, recommended by manufacturer for intended use.
- H. Fasteners: Large-headed galvanized roofing nails, length as recommended by shingle manufacturer, but no less than 1 1/4". Staples not acceptable except to temporarily secure underlayment.
- I. Shingles: Fiberglass base asphalt shingles meeting ASTM D3018 Type 1, and ASTM D3161 or D3462, UL Class "A" fire rating, self-seal down, 40 year (minimum) limited warranty, wood shake appearance, 5 to 5 1/2" exposure, such as:
 - 1. GAF Timberline Series
 - 2. Owens Corning Oakridge Series
 - 3. Certainteed Landmark Series ("Weathered Wood")

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install all products in strict accordance with manufacturer's written instructions. Coordinate with other trades to incorporate accessories and penetrations.
- B. Eave Ice Dam Protection: Remove release paper and press down to adhere directly to clean dry wood roof deck before installing underlayment or other flashings. Apply successive courses from low point to high point. Minimum 6" end laps. Minimum 3½" side laps. Apply from all eave edges to minimum 24" inside the interior face of the exterior walls. Apply 36" strip centered in all valleys after installing eave protection. Install 36" strip turned up 6" against wall sheathing along all higher walls.
- C. Underlayment: After all water protection sheets are installed provide a 19-inch wide eave starter felt with 36-inch wide felt mopped to starter felt with fibercoat mopping. Work from low point to high point, lapping all succeeding 36-inch wide felts 19", including ridge felts. Secure felts to wood deck using a minimum number of staples, until shingles are placed and nailed. Cement felt laps to each other with plastic cement from eaves to minimum 24" inside the interior face of the exterior wall.
- D. Roof Shingles: Install with 5-inch exposure and 2-inch head lap using four (4) large headed roofing nails per shingle. Stagger shingle ends for succeeding courses. All roof ridges shall be covered with the manufacturer's standard ridge shingles and shall have 5-inch exposure and six (6) nails per shingle, all as recommended by the manufacturer. Staple connections will not be accepted.
- E. Valleys: Fully woven shingles, over continuous (lapped) galvanized steel valley flashing, over 36" wide continuous water protection sheet with 6" adhered lap joints. Press valley flashing tightly into valley and nail both edges at 12". Alternating from each side of valley, extend each course of shingles past the valley centerline up the adjoining slope sufficiently to nail each course at least 6" beyond each side of valley centerline. Nail approaching side first, press shingle tightly into valley, and nail other side of valley with 2 nails. If a shingle ends within 6" of either side of valley centerline, cut off one tab of previous shingle and use one whole shingle to cross valley, and nail as above.
- F. Flashings Against Vertical Walls: Install 36-inch wide water protection sheet turned up 6" minimum against wall sheathing, with minimum 6" end laps. Install lapped roof underlayment turned up 6" minimum against wall sheathing. Install shingles with bent metal shingle flashing over preceding shingle pressed firmly into the corner and positioned so horizontal leg is fully concealed by succeeding shingle. Secure each metal shingle flashing to wall only, with (1) galvanized roofing nail positioned behind succeeding shingle flashing. Shingle flashing to extend minimum 4" up wall face, minimum 3" over shingle and shall lap preceding shingle flashing 2" minimum. (Coordinate to complete this work prior to installation of wall siding).
- G. Roof Penetrations: Flash and counterflash for fully watertight, naturally shedding transition to roof shingles.

3.2 ADJUST AND CLEAN

- A. Replace shingles or other products damaged or stained prior to final acceptance.
 - B. Clean premises of all litter, dirt and debris created by work of this Section.
- END OF SECTION 07310

SECTION 07530 - SINGLE-PLY MEMBRANE ROOFING

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Division 1 Specification Sections, as well as individual Delivery Order requirements, apply to this Section.

SUMMARY

Individual Delivery Order Requirements will override this section when issued with the project.

Types of roofing systems specified in this Section using single-ply roofing membranes include the following:

Totally adhered systems.

Single-ply roofing membranes include the following:

Ethylene propylene diene monomer (EPDM).

Roof insulation and parapet drains with downspout elbow related to single-ply membrane roofing are specified in this Section.

Wood nailers, blocking, and other related items are specified in Division 6.

Cap flashings are specified in another Division 7 Section.

Installation of single-ply membrane lined internal gutter is specified in another Division 7 Section.

SUBMITTALS

General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

Product data, installation instructions, and general recommendations from manufacturer of single-ply membrane system for types of roofing required. Include data substantiating that materials comply with requirements.

Samples of finished roofing sheets, including T-shaped side/end-lap seam. Also include the following:

Insulation boards.

Shop drawings showing roof configuration, sheet layout, seam locations, colors (as applicable), details at

perimeter, and special conditions.

Indicate layout of tapered crickets and thickness of insulation materials.

Pre-roofing conference records.

Test data for pullout resistance of fastening systems.

QUALITY ASSURANCE

Manufacturer: Obtain primary single-ply membrane roofing from a single manufacturer. Provide secondary materials as recommended by manufacturer of primary materials.

Installer: Engage an experienced Installer that has specialized in installing roofing systems similar to those required for this Project. Installer must be acceptable to or licensed by manufacturer of primary roofing material.

Work associated with single-ply membrane roofing, including (but not limited to) insulation, flashing, and membrane sheet joint sealers, is to be performed by Installer of this Work.

Pre-Roofing Conference: Before installing roofing and associated Work, meet at project site with Installer, roofing manufacturer, installers of related work, and other entities concerned with roofing performance, including Architect and Owner. Record discussions and agreements and furnish copy to each participant. Provide at least 72 hours advance notice to participants prior to convening pre-roofing conference.

UL Listing: Provide labeled materials that have been tested and listed by UL in "Building Materials Directory" or by other nationally recognized testing laboratory for Class A rated materials/system.

PROJECT CONDITIONS

Weather: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.

Substrate Conditions: Do not begin roofing installation until substrates have been inspected and are determined to be in satisfactory condition.

WARRANTY

Manufacturer's Warranty: Submit executed copy of single-ply membrane manufacturer's agreement signed by an authorized representative of manufacturer.

Warranty Period: 10 years from date of Substantial Completion.

The warranty shall not deprive the Government of other rights the Government may have under other

provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

GENERAL

Performance: Provide roofing materials identified to be of generic type indicated and tested to show compliance with required performances.

Compatibility: Provide products recommended by manufacturers to be fully compatible with indicated substrates. Provide separation materials as required to eliminate contact between incompatible materials.

EPDM MEMBRANE

General: Ethylene propylene diene monomers formed into uniform, flexible sheets, complying with ASTM D 4637, Type 1.

Class SR: Fabric internal reinforced.

Thickness: 45 mils, nominal.

Exposed Face Color: Manufacturer's standard.

Fully Adhered EPDM Membrane: Manufacturer's standard installation.

Manufacturers: Subject to compliance with requirements, provide products of one of the following:

Carlisle Syntec Systems, "Sure-Seal."

Firestone Building Products Co., "RubberGuard."

GenFlex Roofing Systems, GenCorp Polymer Products, "GenFlex ACR".

AUXILIARY MATERIALS

Sheet Seaming System: Manufacturer's standard materials for sealing lapped joints, including edge sealer to cover exposed spliced edges as recommended by membrane manufacturer.

Cant Strips, Tapered Edge Strips, and Flashing Accessories: Types recommended by membrane manufacturer, including adhesive tapes, flashing cements, and sealants.

Flashing Material: Manufacturer's standard system compatible with single-ply membrane.

Membrane Adhesive: As recommended by membrane manufacturer for particular substrate and project conditions, formulated to withstand minimum 60-psf uplift force.

Parapet Drain: Equal to Wade W-3274 Series, cast iron parapet drain with threaded side outlet, 4" diameter and secured cast iron grate and flashing ring. Provide complete with downspout elbow for connection to downspout.

Refer to Division 7 Section "Flashing and Sheet Metal for downspout.

INSULATING MATERIALS

General: Provide insulating materials to comply with requirements indicated for materials and with referenced standards in sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

Polyisocyanurate Board Roof Insulation: Tapered, rigid, cellular, thermal insulation with polyisocyanurate closed-cell foam core and manufacturer's standard facing laminated to both sides; complying with FS HH-I-1972/2, Class 1.

Provide high density insulation board over polyisocyanurate board insulation as recommended by membrane roofing manufacturer.

Insulation shall be as approved by membrane roofing manufacturer to satisfy specified performance criteria and warranty.

Insulation used to form crickets shall be as recommended by membrane roofing manufacturer.

AUXILIARY INSULATION MATERIALS

Adhesive for Bonding Insulation: Type recommended by insulation manufacturer and complying with fire-resistance requirements.

Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints and filling voids.

Mechanical Anchors: Corrosion-resistant type as recommended by insulation manufacturer for deck type and complying with fire and insurance wind-uplift rating requirements.

Provide system tested and approved for I-90 wind-uplift rating.

PART 3 - EXECUTION

PREPARING SUBSTRATE

General: Comply with manufacturers' instructions to prepare substrate to receive single-ply membrane system.

Verify that penetrations, expansion joints, and blocking are in place and secured and that roof drains are

properly clamped into position.

Clean substrate of dust, debris, and other substances detrimental to single-ply system installation. Remove sharp projections.

Install cant strips, flashings, and accessory items as shown and as recommended by manufacturer.

Prime substrate where recommended by manufacturer of materials being installed.

Prevent compounds from entering and clogging drains and from spilling or migrating onto surfaces of other work.

INSTALLING INSULATION

General: Extend insulation full thickness over entire surface to be insulated, cutting and fitting tightly around obstructions. Form cant strips, crickets, saddles, and tapered areas with additional material as shown and as required for proper drainage of membrane.

Do not install more insulation in a day than can be covered with membrane before end of day or before start of inclement weather.

Secure roof insulation to substrate with mechanical anchors of type and spacing as required to comply with wind-uplift rating, but in no case provide less than one anchor per 4 sq. ft. of surface area or less anchorage than required by FM Loss Prevention Data Sheet 1-28.

INSTALLING MEMBRANE

Cut out and repair membrane defects at the end of each day's work.

Fully Adhered Membrane: Install membrane by unrolling over prepared substrate, lapping adjoining sheets as recommended by manufacturer. Apply adhesive to surfaces to be bonded and roll into place when adhesive has properly cured. Treat seams with special adhesive and apply sealant to exposed sheet edges, tapering application as recommended by manufacturer. Install mechanical fasteners, flashings and counterflashings, and accessories at locations as recommended by manufacturer.

INSTALLING PARAPET DRAINS

Install parapet drains and downspout elbows to comply with manufacturer's instructions. Coordinate installation with masonry work. Refer to Specification Section 04200.

PROTECTING ROOFING

After completing roofing (including associated work), institute appropriate procedures for surveillance and protection of roofing during remainder of construction period. At the end of the construction period, or at

a time when remaining construction will in no way affect or endanger roofing, make a final inspection of roofing.

Repair or replace (as required) deteriorated or defective work found at the time of final inspection to a condition free of damage and deterioration at the time of Substantial Completion and according to the requirements of the specified warranty.

END OF SECTION 07530

SECTION 07720 - ROOF ACCESSORIES

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

Roof hatches.

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

Division 5 Sections for ladders and support framing.

Division 7 Section for roofing types and roofing accessories included as part of roofing Work.

SUBMITTALS

General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

Product data for each type of product specified. Submit manufacturer's detailed technical product data, installation instructions and recommendations, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

Shop drawings showing fabrication and installation of each roof accessory specified including fully dimensioned plans, elevations, sections, details of components, and attachments to other units of Work. Also show layout, anchorage details, rough-in requirements, and conditions on the roof or for other accessories.

QUALITY ASSURANCE

Standards: Comply with the following:

SMACNA "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap-flashing to coordinate with type of roofing indicated.

NRCA "Roofing and Waterproofing Manual" details for installation of units.

PART 2 - PRODUCTS

ROOF ACCESSORIES

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MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Roof Hatches:

Bilco Co.
Bristolite Skylights.
Milcor, Inc.
Naturalite/EPI Skylight Systems.
O'Keeffe's, Inc.
Wasco Products, Inc.

MATERIALS, GENERAL

Aluminum Sheets: ASTM B 209 for Alclad alloy 3005H25 or alloy and temper required to suit forming operations with mill finish, unless indicated otherwise.

Extruded Aluminum: ASTM B 221 alloy 6063-T52 or alloy and temper required to suit structural and finish requirements. Mill finish, unless indicated otherwise.

Structural-Quality Galvanized Steel Sheet: ASTM A 446 with G90 coating complying with ASTM A 525, Grade C, or to suit manufacturer's standards.

Commercial-Quality Galvanized Steel Sheet: ASTM A 526 with G90 coating complying with ASTM A 525.

Galvalume-Coated Steel Sheet: ASTM A 792 with class AZ-50 coating, Grade 40, or to suit manufacturer's standards.

Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of thickness indicated.

Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

Where removal of exterior exposed fasteners affords access to building, provide nonremovable fastener heads.

Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coating.

Mastic Sealant: Polyisobutylene, nonhardening, nonskinning, nondrying, nonmigrating sealant.

Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or

ROOF ACCESSORIES

other adhesive compatible with roofing system.

ROOF HATCHES

General: Fabricate units to withstand 40-lbf per sq. ft. external loading and 20-lbf per sq. ft. internal loading pressure. Frame with 9-inch-high, integral-curb, double-wall construction with 1-1/2 inch insulation, cant strips and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints. Provide double-wall cover (lid) construction with 1 inch insulation core. Provide gasketing and equip corrosion-resistant or hot-dip galvanized hardware including pintle hinges, hold-open devices, interior padlock hasps, and both interior and exterior latch handles.

Type: Single-leaf for equipment access (Bilco Type SS-50).

Size: As indicated on drawings.

Material: Aluminum or zinc-coated steel, or in combination, at Contractor's option.

PART 3 - EXECUTION

INSTALLATION

General: Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, vapor barriers, roof insulation, roofing and flashing, as required, to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses, as well as inward and outward loading pressures.

Except as otherwise indicated, install roof accessory items according to construction details of NRCA "Roofing and Waterproofing Manual."

Isolation: Where metal surfaces of units are to be installed in contact with incompatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation.

Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

Operational Units: Test operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

CLEANING AND PROTECTION

Clean exposed metal surfaces according to manufacturer's instructions. Touch up damaged metal coatings.

END OF SECTION 07720

SECTION 07901 - JOINT SEALANTS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes, but is not limited to, joint sealers for the following locations:

Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below.

- Control and expansion joints in exterior walls.
- Joints between different materials.
- Perimeter of joints between materials listed above and frames of doors and windows.
- Other joints as indicated.

Exterior joints in horizontal traffic surfaces as indicated below:

- Control, expansion, and isolation joints in cast-in-place concrete slabs for floors and paving.
- Other joints as indicated.

Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:

- Control and expansion joints on exposed interior walls.
- Perimeter joints of exterior openings where indicated.
- Vertical control joints on exposed surfaces of interior unit masonry walls and partitions.
- Perimeter joints between interior wall surfaces and frames of interior doors and windows.
- Perimeter joints at toilet fixtures.
- Other joints as indicated.

Interior joints in horizontal traffic surfaces as indicated below:

- Control and expansion joints in cast-in-place concrete slabs.

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

Division 7 Section "Firestopping" for fire resistant joint sealers.

Division 7 Section "Flashing and Sheet Metal" for sealing joints related to flashing and sheet metal.

Division 8 Section "Glass and Glazing" for glazing sealants.

Joint sealers in conjunction with mechanical and electrical work are the responsibility of the respective contractors performing that work.

SYSTEM PERFORMANCES

Provide joint sealers that have been produced and installed to establish and maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

All sealant work shall be performed by a Laborer experienced in this type of work.

SUBMITTALS

Product Data from manufacturers for each joint sealer product required, including instructions for joint preparation and joint sealer applications.

Joint Sealer Manual: Prepare and submit a joint sealer manual which shall describe in detail all sealant systems proposed for use, with specific project locations and conditions noted for each system. Include product data as part of the manual.

Samples for Initial Selection Purposes: Manufacturer's standard bead samples consisting of strips of actual products showing full range of colors available, for each product exposed to view.

Samples for verification purposes of each type and color of joint sealer required. Install joint sealer samples in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealers.

Certificates from manufacturers of joint sealers attesting that their products comply with specification requirements and are suitable for the use indicated.

Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

Product test reports for each type of joint sealer indicated, evidencing compliance with requirements specified.

QUALITY ASSURANCE

Installer Qualifications: Engage an Installer who has successfully completed within the last 3 years at least 3 joint sealer applications similar in type and size to that of this Project.

Single Source Responsibility for Joint Sealer Materials: Obtain joint sealer materials from a single manufacturer for each different product required.

Field-Constructed Mock-Ups: Prior to installation of joint sealers, apply elastomeric sealants to selected building joints as directed for further verification of colors selected from sample submittals and to represent completed work for qualities of appearance, materials, and application.

DELIVERY, STORAGE, AND HANDLING

Delivery materials to Project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

Store and handle materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

PROJECT CONDITIONS

Environmental Conditions: Do not proceed with installation of joint sealers under the following conditions:

When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturer or below 40 degrees F (4.4 degrees C).

When joint substrates are wet due to rain, frost, condensation, or other causes.

Joint Width Conditions: Do not proceed with installation of joint sealers where joint widths are less than allowed by joint sealer manufacturer for application indicated.

Joint Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 - PRODUCTS

JOINT SEALANTS

MATERIALS, GENERAL

Compatibility: Provide joint sealers, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

Colors: Provide color of exposed joint sealers as selected from manufacturer's standard colors.

ELASTOMERIC JOINT SEALANTS

Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses.

Multi-Part Nonsag Urethane Sealant for Use NT: Type M, Grade NS, Class 25, and complying with the following requirements for Uses:

Uses NT, M, A, and, as applicable to joint substrates indicated, O.

Multi-Part Pourable Urethane Sealant for Use T: Type M, Grade P, Class 25, and complying with the following requirements for Uses:

Uses T, M, and, as applicable to joint substrates indicated, O.

Products: Subject to compliance with requirements, provide one of the following:

Multi-Part Nonsag Urethane Sealant for Use NT:

"Dynatrol II"; Pecora Corp.

"Dymeric"; Tremco Inc.

Multi-Part, Pourable, Urethane Sealant for Use T:

"Pourthane"; W.R. Meadows, Inc.

"NR-200 Urexpan"; Pecora Corp.

"THC-900"; Tremco Inc.

COLD-APPLIED EXTERIOR CONCRETE JOINT SEALANTS

Silicone Sealant for Concrete: One-part, self-leveling, ultra low-modulus, neutral silicone sealant complying with ASTM C 920 for Type S, Grade as indicated below, Class 25, and as follows:

Grade P for joints in horizontal paved surfaces.

Grade NS for vertical and other joints where installation of a Grade P (self-leveling) sealant would

result in sealant flowing out of joint.

Products: Subject to compliance with requirements, provide the following:

"Dow Corning 890-SL", Dow Corning Corp.

JOINT SEALANT BACKING

General: Provide sealant backings of material and type which are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonwaxing, nonextruding strips of flexible, nongassing plastic foam of material indicated below; nonabsorbent to water and gas; and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

Either open-cell polyurethane foam or closed-cell polyethylene foam, unless otherwise indicated, subject to approval of sealant manufacturer.

Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

MISCELLANEOUS MATERIALS

Primer: Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealer-substrate tests and field tests.

Cleaners for Nonporous Surfaces: Provide nonstaining, chemical cleaners of type which are acceptable to manufacturers of sealants and sealant backing materials, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.

Masking Tape: Provide nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.

Accessory Materials for Fire-Stopping Sealants: Provide forming, joint fillers, packing and other accessory materials required for installation of fire-stopping sealants as applicable to installation conditions indicated.

JOINT FILLERS FOR CONCRETE PAVING AND WALKS

General: Provide joint fillers of thickness and widths indicated.

JOINT SEALANTS

Cellular/Foam Joint Fillers and Sealant Backers: Provide this type of joint filler in all concrete expansion joints which are to receive a sealant joint. (All expansion joints between walks and building and in sidewalk paving except at standard 5'-0" walks).

Products: Subject to compliance with requirements, provide one of the following:

"Vinylfoam"; Sonneborn Building Products

"Ceramar"; W.R. Meadows

PART 3 - EXECUTION

EXAMINATION

Examine joints indicated to receive joint sealers, with Installer present, for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Do not proceed with installation of joint sealers until unsatisfactory conditions have been corrected.

PREPARATION

Surface Cleaning of Joints: Clean out joints immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers and the following requirements:

Remove all foreign material from joint substrates which could interfere with adhesion of joint sealer, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; old joint sealers; oil; grease; waterproofing; water repellents; water; surface dirt; and frost.

Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

Remove laitance and form release agents from concrete.

Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.

Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on preconstruction joint sealer-substrate tests or prior experience. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow

spillage or migration onto adjoining surfaces.

Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

INSTALLATION OF JOINT SEALERS

General: Comply with joint sealer manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications and conditions indicated.

Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths which allow optimum sealant movement capability.

Do not leave gaps between ends of joint fillers.

Do not stretch, twist, puncture, or tear joint fillers.

Remove absorbent joint fillers which have become wet prior to sealant application and replace with dry material.

Install bond breaker tape between sealants and joint fillers, compression seals, or back of joints where adhesion of sealant to surfaces at back of joints would result in sealant failure.

Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.

Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

CLEANING

Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with

cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

PROTECTION

Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installation with repaired areas indistinguishable from original work.

END OF SECTION 07901

SECTION 08111 - STANDARD STEEL DOORS AND FRAMES

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following products manufactured in accordance with SDI Recommended Standards:

Doors: Seamless, hollow or composite construction standard steel doors for interior and exterior locations.

Frames: Pressed steel frames for doors, transoms, sidelights, mullions and other interior and exterior openings of following type:

Welded unit type.

Assemblies: Provide standard steel door and frame assemblies as required for the following:

Labeled and fire rated.

Thermal rated (insulated).

Provide factory primed doors and frames to be field painted.

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

Division 4 Section "Unit Masonry" for building in of anchors and grouting of frames in masonry construction.

Division 8 Section "Finish Hardware" for door hardware.

Division 8 Section "Flush Wood Doors" for wood doors.

Division 8 Section "Access Doors" for access doors.

Division 8 Section "Overhead Coiling Doors" for overhead coiling doors.

Division 8 Section "Glass and Glazing" for glass in steel doors and sidelights.

Division 9 Section "Gypsum Board Assemblies" for anchoring to metal stud partitions.

Division 9 Section "Painting" for painting of doors and frames.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division Specification Sections.

Product data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, profiles, and finishes.

Shop drawings showing fabrication and installation of standard steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

Label Construction Certification: For door assemblies required to be fire-rated and exceeding limitations of labeled assemblies, submit manufacturer's certification that each door and frame assembly has been constructed to conform to design, materials and construction equivalent to requirements for labeled construction.

QUALITY ASSURANCE

Provide doors and frames complying with Steel Door Institute "Recommended Specifications Standard Steel Doors and Frames" ANSI/SDI-100 and as herein specified.

Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies whose fire resistance characteristics have been determined per ASTM E 152 and which are labeled and listed by UL, Factory Mutual, Warnock Hersey, or other testing and inspecting organization acceptable to authorities having jurisdiction.

DELIVERY, STORAGE, AND HANDLING

Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage.

Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Contracting Officer; otherwise, remove and replace damaged items as directed.

Store doors and frames at building site under cover. Place units on minimum 4-inch high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inch spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

STANDARD STEEL DOORS AND FRAMES

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ACCEPTABLE MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide standard steel doors and frames by one of the following:

Standard Steel Doors and Frames:

Amweld Building Products, Inc.
Ceco Corp.
Curries Company.
Fenestra Corp.
Kewanee Corp.
Mesker Door Co.
Pioneer Industries.
Republic Builders Products.
Steelcraft Manufacturing Co.

MATERIALS

Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, or drawing quality, ASTM A 642, hot dipped galvanized in accordance with ASTM A 525, with A60 or G60 coating designation, mill phosphatized.

Supports and Anchors: Fabricate of not less than 18-gage sheet steel, galvanized where used with galvanized frames.

Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize in compliance with ASTM A 153, Class C or D as applicable.

Shop Applied Paint: Apply after fabrication.

Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A 224.1, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

DOORS

Provide metal doors of SDI grades and models specified below and as indicated on drawings or schedules:

Interior Doors: ANSI/SDI-100, Grade II, heavy-duty, Model 3 or 4, minimum 18-gage cold-rolled sheet steel faces.

Exterior Doors: ANSI/SDI-100, Grade III, extra heavy-duty, Model 4, minimum 16-gage galvanized steel faces.

Astragals: Provide metal astragals at each pair of doors.

FRAMES

Provide metal frames for doors, transoms, side lights, mullions, borrowed lights, and other openings, of types and styles as shown on drawings and schedules. Conceal fastenings, unless otherwise indicated.

Fabricate frames with mitered and welded corners.

Fabricate interior frames from 16-gage cold-rolled steel.

Form exterior frames from 14-gage galvanized steel.

Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.

Plaster Guards: Provide minimum 26-gage steel plaster guards or mortar boxes at back of hardware cutouts to close off interior of openings.

FABRICATION

Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site. Comply with ANSI/SDI-100 requirements.

Internal Construction: Manufacturer's standard honeycomb, polyurethane, polystyrene, unitized steel grid, vertical steel stiffeners, or rigid mineral fiber core with internal sound deadener on inside of face sheets where appropriate in accordance with SDI standards.

Clearances: Not more than 1/8 inch at jambs and heads except between non-fire-rated pairs of doors not more than 1/4 inch. Not more than 3/4 inch at bottom.

Fabricate exposed faces of doors from cold-rolled steel.

Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."

Fabricate frames, concealed stiffeners, reinforcement, edge channels, and moldings from either cold-rolled or hot-rolled steel.

Fabricate exterior doors and frames from galvanized sheet steel in accordance with SDI-112. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 16-gage inverted steel channels.

Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 236 or ASTM C 976 on fully operable door assemblies.

Unless otherwise indicated, provide thermal-rated assemblies with U factor of 0.41 Btu/(hr x sq ft x deg F.) or better.

Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A 115 Series Specifications for door and frame preparation for hardware.

Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at project site.

Hardware reinforcement shall be 3/16" thick minimum.

Locate hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames," published by Door and Hardware Institute.

Shop Painting: Clean, treat, and paint all surfaces of steel door and frame units, including galvanized surfaces.

Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

Glazing Stops: Minimum 20 gage steel.

Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass and other panels in doors.

PART 3 - EXECUTION

INSTALLATION

General: Install standard steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.

Placing Frames: Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames," unless otherwise indicated.

Except for frames located at concrete or masonry installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

In masonry construction, locate 4 wall anchors per jamb adjacent to hinge locations on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry Tee anchors.

Install fire-rated frames in accordance with NFPA Standard No. 80.

Install all hollow metal units plumb, rigid, and in true alignment. Frames shall be anchored to floor, jambs and to structure above as required for lateral bracing. Floor anchorage shall be two anchors spaced a minimum of 3" apart.

Door Installation: Fit hollow metal doors accurately in frames, within clearances specified in ANSI/SDI-100.

Install fire-rated doors with clearances as specified in NFPA Standard No. 80.

ADJUST AND CLEAN

Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

Final Adjustments: Check and readjust operating hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION 08111

SECTION 08211 - FLUSH WOOD DOORS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.

SUMMARY

Extent and location of each type of flush wood door is indicated on drawings and in schedules.

Types of doors required include the following:

Solid core flush wood doors with wood veneer faces.

Factory-prefitting to frames and factory-premachining for hardware for wood doors is included in this section.

Metal door frames for flush wood doors are specified in another Division-8 section.

SUBMITTALS

Product Data: Door manufacturer's technical data for each type of door, including details of core and edge construction, trim for openings.

Shop Drawings: Submit shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for factory finishing and other pertinent data.

For factory-premachined doors, indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light openings.

Samples: Submit samples, 1-0" square or as indicated, for the following:

Doors for Transparent Finish: Door faces with solid wood edging representing typical range of color and grain for each specie of veneer and solid lumber required.

Metal Frames for Light Openings: Metal light frames in 6" lengths; for each material, type and finish required.

QUALITY ASSURANCE

Quality Standards: Comply with the following standards:

NWWDA Quality Standard: I.S.1 "Industry Standard for Wood Flush Doors", of National Wood Window and Door Association (NWWDA).

AWI Quality Standard: "Architectural Woodwork Quality Standards"; including Section 1300 "Architectural Flush Doors", of Architectural Woodwork Institute (AWI) for grade of door, core construction, finish and other requirements exceeding those of NWWDA quality standard.

Fire-Rated Wood Doors: Provide wood doors which are identical in materials and construction to units tested in door and frame assemblies per ASTM E 152 and which are labeled and listed for ratings indicated by UL, Warnock Hersey or other testing and inspection agency acceptable to authorities having jurisdiction.

Manufacturer: Obtain doors from a single manufacturer.

PRODUCT DELIVERY, STORAGE, AND HANDLING

Protect doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standards and recommendations of NWWDA pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors", as well as with manufacturer's instructions.

Identify each door with individual opening numbers which correlate with designation system used on shop drawings for door, frames, and hardware, using temporary, removable or concealed markings.

PROJECT CONDITIONS

Conditioning: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period to comply with the following requirements applicable to project's geographical location:

Referenced AWI quality standard including Section 100-S-3 "Moisture Content"...

WARRANTY

General: Warranties shall be in addition to, and not a limitation of, other rights the Government may have under the Contract Documents.

Door Manufacturer's Warranty: Submit written agreement in door manufacturer's standard form signed by Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup or twist) or that show telegraphing of core construction in face veneers, or do not conform to tolerance limitations of referenced quality standards.

Warranty shall also include reinstallation which may be required due to repair or replacement of

defective doors where defect was not apparent prior to hanging.

Warranty shall be in effect during following period of time after date of Substantial Completion.

Solid Core Interior Doors:

Life of installation.

Contractor's Responsibilities: Replace or refinish doors where Contractor's work contributed to rejection or to voiding of manufacturer's warranty.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide products of one of the following:

Solid Core Doors with Wood Veneer Faces:

Algoma Hardwoods, Inc.
Eggers Industries, Architectural Door Division.
Graham Manufacturing Corp.
Mohawk Flush Doors, Inc.
Weyerhaeuser Company.

INTERIOR FLUSH WOOD DOORS

Solid Core Doors for Transparent Finish: Comply with the following requirements:

Faces: Red oak, plain sliced with similar grain pattern.

AWI Grade: Premium.

Construction: PC-5 or PC-7 (Particleboard core, 5- or 7-ply).

Fire-Rated Solid Core Doors: Comply with the following requirements.

Faces and AWI Grade: Provide faces and grade to match non-rated doors in same area of building, unless otherwise indicated.

Construction: Manufacturer's standard core construction as required to provide fire-resistance rating indicated.

FLUSH WOOD DOORS

Edge Construction: Provide manufacturer's standard laminated edge construction for improved screw-holding capability and split resistance as compared to edges composed of a single layer of treated lumber.

Provide fire-rated pairs with fire-retardant stiles which are labeled and listed without formed steel edges and astragals unless otherwise indicated.

LIGHT FRAMES

Metal Frames for Light Openings in Doors: Manufacturer's standard frame formed of 18-gage cold-rolled steel, factory-primed, and approved for use in door of fire-rating indicated. Refer to schedules for sizes and locations.

Equal to Weyerhaeuser #118.

FABRICATION

Fabricate flush wood doors to produce doors complying with following requirements:

Factory-prefit and premachine doors to fit frame opening sizes indicated with the following uniform clearances and bevels:

Comply with tolerance requirements of AWI for prefitting. Comply with final hardware schedules and door frame shop drawings and with hardware templates.

Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory premachining.

Edge Banding: All doors shall be edge banded with same specie as door face.

Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of doors required.

Light Openings: Trim openings with metal frames as specified.

PART 3 - EXECUTION

EXAMINATION

Examine installed door frames prior to hanging door:

Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.

FLUSH WOOD DOORS

Reject doors with defects.

Do not proceed with installation until unsatisfactory conditions have been corrected.

INSTALLATION

Hardware: For installation see Division-8 "Finish Hardware" section of these specifications.

Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and off referenced AWI standard and as indicated.

Install fire-rated doors in corresponding fire-rated frames in accordance with requirements of NFPA No. 80.

Fitting Clearances for Fire-Rated Doors: Complying with NFPA 80.

Prefit Doors: Fit to frames for uniform clearance at each edge.

Field-Finished Doors: Refer to the following finishing requirements:

Division - 9 Section "Painting".

ADJUSTING AND PROTECTION

Operation: Rehang or replace doors which do not swing or operate freely.

Finished Doors: Refinish or replace doors damaged during installation.

Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 08211

SECTION 08305 - ACCESS DOORS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes access doors for installation in the following types of construction:

Gypsum drywall.

Masonry.

Provide fire-rated access doors where required.

SUBMITTALS

Product data in form of manufacturer's technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions, and directions for installation of anchorage devices.

Include general locations, sizes, wall and ceiling construction details, finishes, latching or locking provisions, and other data pertinent to installation.

QUALITY ASSURANCE

Single-Source Responsibility: Obtain access doors for entire project from one source from a single manufacturer.

Fire-Resistance Ratings: Wherever a fire-resistance classification is required, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.'s "Building Materials Directory" for rating shown.

Provide UL label on each fire-rated access door.

Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

PROJECT CONDITIONS

Verification: Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment.

All valves, damper controls, adjusting devices, and all other items and devices requiring adjustment or service shall be accessible. General Contractor shall verify locations with Mechanical Contractor, Electrical Contractor, and other trades and shall provide access doors at all locations as required.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide access doors by one of the following:

Cesco Products
J.L. Industries
Milcor, Inc.

MATERIALS AND FABRICATION

General: Furnish each access door assembly manufactured as an integral unit, complete with all parts, and ready for installation.

Steel Access Doors and Frames: Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.

Frames: Fabricate from 16-gage steel.

Fabricate frame with exposed flange nominal 1-inch wide around perimeter of frame for units installed in the following construction:

Drywall finish.

For gypsum drywall, furnish perforated frames with drywall bead.

For installation in masonry construction, furnish frames with adjustable metal masonry anchors.

Flush Panel Doors: Fabricate from not less than 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees. Finish with manufacturer's factory-applied prime paint.

For fire-rated units, provide manufacturer's standard insulated flush door with continuous piano hinge and self-closing mechanism.

Locking Devices: Furnish flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.

Provide one cylinder lock per access door. Furnish two keys per lock. Key all locks alike, unless otherwise scheduled.

PART 3 - EXECUTION

INSTALLATION

Comply with manufacturer's instructions for installation of access doors.

Coordinate installation with work of other trades.

Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

ADJUST AND CLEAN

Adjust hardware and panels after installation for proper operation.

Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08305

SECTION 08307 - FLOOR DOORS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes floor doors.

SUBMITTALS

Product data in form of manufacturer's technical data and installation instructions for each type of floor door assembly, including setting drawings, templates, instructions, and directions for installation of anchorage devices.

Include general locations, sizes, floor construction details, finishes, latching or locking provisions, and other data pertinent to installation.

QUALITY ASSURANCE

Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of floor doors. Coordinate delivery with other work to avoid delay.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturers of Floor Doors: Subject to compliance with requirements provide floor doors as manufactured by the Bilco Company or approved equal.

MATERIALS AND FABRICATION

General: Furnish each floor door assembly manufactured as an integral unit, complete with all parts, and ready for installation.

FLOOR DOORS

Single Leaf, Extruded Frame: Door leaf shall be 1/4" aluminum diamond pattern plate reinforced with aluminum stiffeners to withstand minimum live load of 300 pounds per square foot. Frame shall be 1/4" extruded aluminum with an anchor flange around the perimeter and have a minimum cross section area of 7½ square inches to allow for adequate water drainage.

Door shall be equipped with heavy forged brass hinges having 3/8" minimum diameter stainless steel pins and pivot so that the cover does not protrude into the channel frame. Compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature. The door shall automatically lock in the vertical position by means of a heavy steel hold-open arm with release handle. A Type 316 stainless steel snap lock with a gasketed cover plug and removable turn handle shall be provided. A 1-1/2" drainage coupling shall be located in the front right corner of the channel frame. Hardware shall be zinc plated and chromate sealed and all fasteners shall be Type 316 stainless steel.

Size: 3'-0" x 2'-6".

Aluminum shall be mill finish with bituminous coating applied to exterior of frame.

Provide Bilco, "J-3AL".

PART 3 - EXECUTION

INSTALLATION

Comply with manufacturer's instructions for installation of floor doors.

Coordinate installation with work of other trades.

Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

ADJUST AND CLEAN

Adjust hardware and panels after installation for proper operation.

Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08307

SECTION 08331 - OVERHEAD COILING DOORS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes overhead coiling metal doors.

Types of overhead coiling doors include the following:

- Overhead fire-rated service doors.

- Insulated overhead doors.

Operation of overhead coiling doors include the following:

- Electric motor operation.

Provide complete operating door assemblies including door curtains, guides, counterbalance mechanism, hardware, and installation accessories.

Field painting is specified in Division 9.

Electrical connections for powered operators and accessories are specified in Division 16.

SUBMITTALS

General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

Product data, roughing-in diagrams, and installation instructions for each type and size of overhead coiling door.

- Provide operating instructions and maintenance information, and complete information describing fire release system including electrical rough-in instructions.

Shop drawings for special components and installations that are not dimensioned or detailed in manufacturer's data sheets.

QUALITY ASSURANCE

Manufacturer's Qualifications: Furnish each overhead coiling door as a complete unit produced by one manufacturer, including hardware, accessories, mounting and installation components.

Furnish overhead coiling door units by one manufacturer for entire Project.

Insert and Anchorages: Furnish inserts and anchoring devices to install units. Provide setting drawings, templates, instructions, and directions to install anchorage devices. Coordinate delivery with other work to avoid delay.

See concrete and masonry Sections of these specifications regarding installation of inserts and anchorage devices.

Wind Loading: Design and reinforce overhead coiling doors to withstand a 20-psf (85-mph) wind-loading pressure.

Fire Door Assemblies: Furnish fire door assemblies which comply with NFPA No. 80 and have been fire tested, rated and labeled in accordance with ASTM E 152. Furnish each door with a metal UL label as evidence of rating, with label indicating rating in hours of duration of exposure to fire and letter designation of location for which assembly is designed.

Automatic Closing: Provide automatic closing device and governor, operating when activated by temperature rise and melting of 160 degrees F (71 degrees C) fusible link. Construct governor unit to be inoperative during normal door operations. Design release mechanism for easy resetting.

Fabricate unit to permit manual lifting of curtain for emergency exit after automatic closing, with curtain returning to closed position when released.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide products by one of the following:

Overhead Door Corp.
Raynor Garage Door.

DOOR CURTAIN MATERIALS AND CONSTRUCTION

Door Curtain: Fabricate overhead coiling door curtain of interlocking slats, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of material gage recommended by door manufacturer for size and type of door required, and as follows:

Steel Door Curtain Slats: Structural quality, cold-rolled galvanized steel sheets complying with

ASTM A 446, Grade A, with G90 zinc coating, complying with ASTM A 525, and phosphate treated before fabrication. Minimum 22-gage unless heavier gage required by wind loading or recommended by manufacturer.

Furnish manufacturer's flat-face slats equal to Overhead Door Corp. Series F-265 for uninsulated doors and F-265 I for insulated door. Appearance of slats between insulated doors and uninsulated doors shall be the same.

Insulated Curtain Slats: Provide doors with insulated slats consisting of 3/4" thick polyurethane-formed-in-place insulation with 24 gage back cover. Slat configuration shall otherwise be identical with other doors on project.

Endlocks: Malleable iron castings galvanized after fabrication, secured to curtain slats with galvanized rivets. Provide locks on alternate curtain slats for curtain alignment and resistance against lateral movement.

Windlocks: Malleable iron castings secured to curtain slats with galvanized rivets. Unless otherwise recommended by door manufacturer, provide windlocks on doors exceeding 16 feet wide. Space windlocks approximately 24 inches o.c. on both edges of curtain.

Bottom Bar: Consisting of 2 angles, each not less than 1" x 1" x 1/8" thick, galvanized with foam rubber astragal for sill protection.

Curtain Jamb Guides: Fabricate curtain jamb guides of steel angles, or channels and angles with sufficient depth and strength to retain curtain loading. Build up units with minimum 3/16-inch thick steel sections, galvanized after fabrication. Slot bolt holes for track adjustment.

Secure continuous wall angle to wall framing with a minimum of 3/8-inch bolts at not more than 30 inches o.c., unless closer spacing recommended by door manufacturer. Extend wall angles above door opening head to support coil brackets, unless otherwise indicated. Place anchor bolts on exterior of wall guides so they are concealed when door is in closed position. Provide removable stops on guides to prevent over-travel of curtain and a continuous bar for holding windlocks.

Weather Seals: Provide vinyl or neoprene weatherstripping for exterior exposed doors, except where otherwise indicated. At door heads, use 1/8-inch thick continuous sheet secured to inside of curtain coil hood. At door jambs, use 1/8-inch thick continuous strip secured to exterior side of jamb guide.

COUNTERBALANCING MECHANISM

General: Counterbalance doors by means of adjustable steel helical torsion spring, mounted around a steel shaft and in a spring barrel, and connected to door curtain with required barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

Counterbalance Barrel: Fabricate spring barrel of hot-formed structural-quality carbon steel, welded or seamless pipe, of sufficient diameter and wall thickness to support roll-up of curtain without distortion of

slats and to limit barrel deflection to not more than 0.03 inch per foot of span under full load.

Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast steel barrel plugs to secure ends of springs to barrel and shaft.

Fabricate torsion rod for counterbalance shaft of cold-rolled steel in size required to hold fixed spring ends and carry torsional load.

Brackets: Provide mounting brackets of manufacturer's standard design, cold-rolled steel plate with bell mouth guide groove for curtain.

Hood: Form to entirely enclose coiled curtain and operating mechanism at opening head and act as weather seal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.

Fabricate steel hoods for doors of not less than 0.0276-inch thick (24-gage) hot-dip galvanized steel sheet with G 90 zinc coating, complying with ASTM A 525.

Furnish automatic drop baffle to guard against passage of smoke or flame.

PRIME PAINTING

General: Shop-clean and prime ferrous metal and galvanized surfaces, exposed and unexposed, except tightly joined and lubricated surfaces, with door manufacturer's standard rust-inhibitive primer. Use primer that is compatible with finish painting.

ELECTRIC DOOR OPERATORS

General: Furnish electric door operator assembly of size and capacity recommended and provided by door manufacturer; complete with electric motor and factory-prewired motor controls, gear-reduction unit, solenoid-operated brake, remote control stations, control devices, conduit and wiring from controls to motor and central stations, and accessories required for proper operation.

Provide explosion-proof motors, equipment and devices at hazardous locations.

Provide hand-operated disconnect or a mechanism for automatically engaging a sprocket-and-chain operator and releasing brake for emergency manual operation. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

Design operator so that motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.

Door Operator Type: Provide wall or bracket-mounted door operator units consisting of electric motor, worm gear drive from motor to reduction gear box, chain or worm gear drive from reduction box to gear wheel mounted on counterbalance shaft, and a disconnect-release for manual operation. Provide motor and drive assembly of horsepower and design as determined by door manufacturer for size of door required.

Electric Motors: Provide high-starting torque, reversible, Class A insulated electric motors with overload protection. Size motor to move door in either direction, from any position, at not less than 2/3 foot nor more than 1 foot per second.

Coordinate wiring requirements and current characteristics of motors with building electrical system.

Furnish open drip-proof type motor.

Furnish totally enclosed, nonventilated type motors, fitted with plugged drain, for exterior applications and where indicated.

Remote Control Stations for Doors at Enclosed Hangar: Provide two (2) momentary-contact, three-button control stations with push-button controls labeled "Open", "Close", and "Stop" for each door at Enclosed Hangar. All Control stations for interior use as listed below.

Remote Control Stations for Exterior Door: Provide one (1) momentary-contact, three-button control station with push-button controls labeled "Open", "Close", and "Stop" for interior use and provide one (1) unit for exterior use as listed below.

Provide interior units full-guarded, surface-mounted, heavy-duty, with general-purpose NEMA Type 1 enclosure.

Provide exterior unit, full-guarded type, standard-duty, surface-mounted, weatherproof, NEMA Type 4 enclosure, key-operated.

Automatic Reversing Control: Furnish each door with an automatic safety switch, extending the full width of door bottom, and located within neoprene or rubber astragal mounted to bottom door rail.

Contact with switch before closing will immediately stop downward travel and reverse direction to fully opened position.

Connect to control circuit through retracting safety cord and reel, or self-coiling cable.

Provide electrically actuated automatic bottom bar.

PART 3 - EXECUTION

INSTALLATION

General: Install door and equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports according to final shop drawings, manufacturer's instructions, and as specified.

Install fire-rated doors to comply with NFPA 80.

After completing installation, including work by other trades, lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion.

Train Government's maintenance personnel on procedures and schedules related to door operation, servicing, preventive maintenance, and procedures for resetting closing devices after activation.

Test door closing when activated by operation of smoke detector fire release system.

END OF SECTION 08331

SECTION 08333 - ROLLING COUNTER DOORS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes overhead coiling metal doors.

Types of overhead coiling doors include the following:

Rolling counter fire doors.

Operation of overhead coiling doors include the following:

Manual operation.

Provide complete operating door assemblies including door curtains, guides, counterbalance mechanism, hardware, and installation accessories.

Field painting is specified in Division 9.

SUBMITTALS

General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

Product data, and installation instructions for each type and size of overhead coiling door.

Provide operating instructions and maintenance information.

Shop drawings for special components and installations that are not dimensioned or detailed in manufacturer's data sheets.

UL label certification for fire-rated doors and frames that each assembly has been constructed with materials and methods for labeled construction.

QUALITY ASSURANCE

Manufacturer's Qualifications: Furnish each overhead coiling door as a complete unit produced by one manufacturer, including hardware, accessories, mounting and installation components.

Furnish overhead coiling door units by one manufacturer for entire Project.

Insert and Anchorages: Furnish inserts and anchoring devices to install units. Provide setting drawings, templates, instructions, and directions to install anchorage devices. Coordinate delivery with other work to avoid delay.

Fire Door Assemblies: Furnish fire door assemblies that comply with NFPA No. 80 and have been fire tested, rated, and labeled according to ASTM E 152. Furnish each door with a metal UL label as evidence of rating, with label indicating rating in hours of duration of exposure to fire, and a letter designation of location for which the assembly is designed.

Automatic Closing: Provide automatic closing device and governor, operating when activated by temperature rise and melting of 160 degrees F (71 degrees C) fusible link. Construct governor unit to be inoperative normal door operations. Design release mechanism to reset easily.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide products by one of the following:

Overhead Door Corp., "Series 640".
Raynor Garage Door, "Series UCP".

DOOR CURTAIN MATERIALS AND CONSTRUCTION

Door Curtain: Fabricate overhead coiling door curtain of interlocking slats, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of material gage recommended by door manufacturer for size and type of door required, and as follows:

Steel Door Curtain Slats: Structural quality, minimum 22 gage, cold-rolled galvanized steel sheets complying with ASTM A 446, Grade A, with G90 zinc coating, complying with ASTM A 525.

Furnish manufacturer's standard "flat-face" slats equal to Overhead Door Series F-265.

Endlocks: Malleable iron castings galvanized after fabrication, secured to curtain slats with galvanized rivets. Provide locks on alternate curtain slats for curtain alignment and resistance against lateral movement.

Bottom Bar: Galvanized 1-1/2" x 1-1/2" x 1/8" angle with foam rubber astragal for sill protection.

Curtain Jamb Guides: Fabricate curtain jamb guides of steel angles, or channels and angles with sufficient depth and strength to retain curtain loading. Build up units with minimum 13-gage steel sections, galvanized after fabrication. Slot bolt holes for track adjustment.

Secure continuous wall angle to wall framing with bolts at not more than 30 inches o.c., unless closer

spacing recommended by door manufacturer. Extend wall angles above door opening head to support coil brackets, unless otherwise indicated. Place anchor bolts on Kitchen side of wall so they are concealed when door is in closed position. Provide removable stops on guides to prevent over-travel of curtain.

COUNTERBALANCING MECHANISM

General: Counterbalance doors by means of adjustable steel helical torsion spring, mounted around a steel shaft and in a spring barrel, and connected to door curtain with required barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

Counterbalance Barrel: Fabricate spring barrel of hot-formed structural-quality carbon steel, welded or seamless pipe, of sufficient diameter and wall thickness to support roll-up of curtain without distortion of slats and to limit barrel deflection to not more than 0.03 inch per foot of span under full load.

Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast steel barrel plugs to secure ends of springs to barrel and shaft.

Fabricate torsion rod for counterbalance shaft of cold-rolled steel in size required to hold fixed spring ends and carry torsional load.

Brackets: Provide mounting brackets of manufacturer's standard design, cold-rolled steel plate with bell mouth guide groove for curtain.

Hood: Form to entirely enclose coiled curtain and operating mechanism at opening head and act as weather seal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.

Fabricate steel hoods for doors of not less than 0.0276-inch thick (24-gage) hot-dip galvanized steel sheet with G 90 zinc coating, complying with ASTM A 525.

Furnish automatic drop baffle to guard against passage of smoke or flame.

PRIME PAINTING

General: Shop-clean and -prime ferrous metal and galvanized surfaces, exposed and unexposed, except tightly joined and lubricated surfaces, with door manufacturer's standard rust-inhibitive primer. Use primer that is compatible with finish painting.

MANUAL DOOR OPERATORS

Provide manual operators.

Manual Push-Up Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lb.

ROLLING COUNTER DOORS

Provide galvanized steel lifting handle and slide bolt lock on inside bottom bar.

PART 3 - EXECUTION

INSTALLATION

General: Install door and equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports according to final shop drawings, manufacturer's instructions, and as specified.

Install fire-rated doors to comply with NFPA 80.

After completing installation, including work by other trades, lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion.

Test door closing when activated by fire-release system. Reset door-closing mechanism after successful test.

END OF SECTION 08331

SECTION 08370 - OVERHEAD HOIST-UP FABRIC DOOR

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Division 1 Specification sections, apply to work of this section.

SUMMARY

Extent of the overhead hoist-up fabric doors is indicated on the drawings.

Related Sections:

Section 05120 "Structural Steel" for primary and secondary structural steel.

Section 05500 "Metal Fabrications" for miscellaneous steel.

DESIGN AND PERFORMANCE REQUIREMENTS:

Door Design: The manufacturer shall design the door in accordance with the criteria specified herein. Doors shall operate properly without binding, interference, or damage to the adjacent structure.

Wind Load: Doors shall be designed to withstand a wind pressure of 25 psf acting alternately inward and outward.

Door Speed: Door shall open fully in less than 150 seconds under all design conditions.

Door Weight: The door manufacturer shall provide load diagrams of the doors in the closed and open positions. Details shall also be provided showing clearance and attachment requirements for coordination with the structural steel and miscellaneous steel shop drawings. The maximum hangar door leaf weight shall not exceed 35,000 pounds.

REFERENCE STANDARDS

The following standards form a part of this specification to the extent referenced. References in the body of this specification are by basic designation only.

National Fire Protection Association

NFPA 701 Large Scale Test (Sheets)

Federal Test Method Standards

FTMS 191A Hydrostatic Resistance (5512)

FTMS 191A Adhesion of Coatings - lbs./2" (5970)

FTMS 191A Stiffness-cms Warp (5204)

FTMS 191A Strength (5041, 5100, 5102, 5304, 5804, 5872)

FTMS 191 Flame Test (5903)

SUBMITTALS

Product Data: Submit manufacturer's technical product data.

Shop Drawings: Submit design drawings detailing door characteristics including size, clearances, and load diagrams; construction details for jamb, head, sill, mullion pit, mullion pit covers, and mullion wind bracing; material types, sizes, shapes, thicknesses, joints and connections; hardware, safety devices, and mechanical device descriptions including motor sizes in HP, voltage, phase and hertz; location of control panels and drive units; wiring diagrams; and all design and detail data for work of other trades affected by the installation of the overhead hoist-up fabric door.

Samples for initial selection purposes in form of manufacturer's color charts or chips showing full range of colors, textures, and patterns available for door fabric.

Samples for verification purposes of fabric: Provide samples 24 inches x 24 inches in the color indicated. Include fasteners, closures, and other accessories.

Operation and Maintenance Manuals: Furnish the following in duplicate at the completion of the installation:

Complete schematic wiring diagram for doors.

Complete manufacturer's manuals containing instructions for operation and maintenance of doors.

QUALITY ASSURANCE

The material, construction and operation of the door shall conform to the performance specifications contained herein.

Manufacturer and Installer Qualifications: The overhead hoist-up fabric doors shall be the product of a manufacturer who has had at least ten (10) years experience in design, fabrication, erection, and service, and who is regularly engaged in the manufacture of the type of door specified herein. Only manufacturers who can submit evidence of actual installations of comparable design and construction, and that the products have proven practical, durable, and require a minimum of maintenance, will be qualified under this specification.

Installation of the doors shall be by an authorized representative of the door manufacturer with at least ten (10) years of experience in the installation of large hangar doors; and shall be in accordance with approved shop drawings. Mechanics shall be skilled and experienced in the erection of large hangar doors of the type specified herein.

Design of the door system structural components shall be under the direct supervision of a Professional Engineer experienced in design of the door system and be registered in the state in which the project is

constructed.

Conform to applicable standards for system fire resistance ratings and flame/fuel/smoke rating of finish.

Pre-Installation Conference: Convene one week prior to commencing work of this Section. Require attendance of parties directly affecting work of this Section. Review conditions of installation, installation procedures, and coordination with related work.

DELIVERY, STORAGE AND HANDLING

Delivery of materials shall be in original rolls, packages, boxes, or crates bearing the manufacturers name, brand, model number, and installation location. Store all materials in dry locations with adequate ventilation, free from dust and water, and available for inspection and handling. Handle doors carefully to prevent damage. Remove damaged items that cannot be restored to like-new condition and replace with new items.

WARRANTY

Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair doors that fail in materials or workmanship within the specified warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Government may have against the Contractor.

Special Project Period is 5 years after date of Substantial Completion.

PROJECT CONDITIONS

Field Measurements: Check openings by field measurement before fabrication to ensure proper fitting of work; show measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the work. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

EXTRA MATERIALS

Provide two sets of repair kits with approximately 100 square feet of fabric and all other materials required for door panel repair, in each kit.

PART 2 - PRODUCTS

Manufacturers: Subject to compliance with requirements, provide overhead hoist-up fabric door by the following or approved equal:

Megadoor, Inc. - 1500 Series where shown on the plan.

Megadoor, Inc. - 1000 Series where shown on the plan.

Door Fabric: The fabric materials shall be a heavy-duty vinyl coated fabric weighing approximately 19-22

ounces per square yard, capable of carrying 250 pounds per inch per panel. It shall be UV stabilized, self-extinguishing (0-75 flame spread, and suitable to withstand temperatures between +158 to -38° F. The fabric shall be attached to both sides of the intermediate beams, top beam, and bottom beam with self-tapping stainless steel screws through aluminum batten strips.

Door Beams: The intermediate beams shall be extruded aluminum and have a suitable depth dependent on the door width and the wind load requirements. They shall be spaced 3-6 feet apart, dependent upon the wind load. At each end of the beams there shall be a shoe of self-lubricating nylon material, or rollers that run along the guides.

Door Guides: The vertical guides shall be an integral part of the door, made of extruded aluminum with a suitable depth and width dependent on the size of the intermediate beams. The guides shall have weather-seals on the inside and outside faces. There shall also be a space inside the guides for the polyester belts or steel cables of the drive unit and safety arrestors. The installer shall furnish an anchorage of size and type required for attaching the guide rails to the jambs, as shown on the reviewed shop drawings.

Drive Units: The door shall have an appropriate number of drive units dependent upon the height and weight of the door leaf. The drive unit horsepower shall be sized as required to operate the door leaf. The gear motor shall be equipped with a drum on which the polyester belt or steel cables are wound. If only one drive unit is used, both belts/cables shall be wound on the same drum. The belts/cables shall be bolted to the bottom beam via the safety arrestors. A hand crank shall be supplied which fits on the shaft of the motor for manual operation of the door in the event of power failure.

Belt/Cable System: A maximum of two belts/cables per door, running inside the door guides, shall be used to transmit motive force to the door unit. Similarly, the quantity of sheaves used to guide the belts/cables shall be minimized to reduce maintenance requirements and replacement part inventories. Belts/cables shall be installed free of any kinks and the system design and sheave diameter shall be such to prevent the occurrence of any kinks or abnormal stress in the operating belts/cables. Field cutting of cables with hatchets, power saws, or other unsafe methods shall not be allowed. Where belts/cables pass through openings in the building structure the openings shall be constructed as to prevent abrasion, wear, and damage to the adjacent structure. Sheave units shall be installed in accessible locations which allow inspection and preventive maintenance. Sheaves shall not be located in enclosed locations which are not readily accessible for visual inspection.

Safety Arrestors: Each door leaf shall be supplied with two safety arrestors which activate and support the door in the event a belt or cable should break. The moveable mullions, shall be provided with a lifting motor which has an internal safety device to prevent the mullion from falling in case of motor or primary brake failure.

Slack Belt/Cable Breaker: A safety device shall be used on all door leaf belts/cables which will sense a slack belt/cable condition and cut power to the appropriate drive unit to prevent an unsafe condition.

Bottom Beam: The bottom beam shall be designed with a suitable width and depth to carry the load of the intermediate beams when the door is open, and to ensure full closing and a tight floor seal in extreme winds. A heavy U-beam bottom rubber seal shall be provided to form a tight seal with the floor, even on

uneven surfaces.

Wind Lock: Each door leaf shall be provided with two wind locks which activate and lock the bottom beam when the door reaches its closed position. This locking action shall act to maintain a tight floor seal and intermediate beam stability even under conditions of heavy wind.

Swing-up Mullion: The swing-up mullions, where indicated on the drawings, shall be designed to swing up under the door leaf in the raised position. They shall be constructed of steel and coated with paint primer. The mullion hinge pivot shall be of a maintenance free bearing design. A mullion pit cover shall be provided for each mullion, with hinged coverplates, to be welded to the mullion pit frame. The mullion pit frame is to be provided under the Miscellaneous Steel Section. The electrical control panel shall provide for a logic device to interface the door leaf operation with movement of the mullions to prevent equipment damage. Mullion push buttons for both up and down operation, in the control panel, shall be of the constant pressure type.

Header Box: Header boxes, when provided, shall be constructed of carbon steel and factory primed with rust inhibitive paint. The System 1000 header box steel components shall be powder-coated paint system.

Control Panel: The door manufacturer shall supply control panels for installation by the electrical subcontractor to operate the door units. In multiple door operations with swing up mullions, the control panel shall contain devices to control the logic sequence of operations to ensure safe operation. The control panels shall also contain interlocks to preclude personnel injury, including an interlock between the power supply system and use of the hand crank for manual operation of the door unit. Provide one main control panel and two remote push-button stations for the Hangar Bay door.

Work of Other Trades: Refer to Division 16 Sections for related electrical work to install manufacturer furnished pre-wired control panels, including furnishing and installing all wire, conduit, and accessories to connect all electrical door items in accordance with manufacturers wiring diagram and National Electrical Code. Electrical Contractor shall cooperate and work with door installer during installation and testing operation of doors to correct any missing or incorrectly wired devices. Refer to Section 05500 Metal Fabrications, for preparation of building head, jamb, and mullion pit steel for attachment of guide rails, header boxes, hoist motor platforms, sheave plates, limit switch brackets, mullion pit steel, mullion lifting motors, and safety arrestor supports.

OPERATION

Door Operation: The overhead hoist-up fabric door shall guide up and down in the weather sealing vertical guides attached to the structure. The door shall operate by lifting the bottom beam upwards, thereby stacking the intermediate beams one on top of the other, with the fabric panel folding in pleats. The fabric panel shall go over the top beam, covering both sides of the door, and shall be attached to the intermediate beams by screws and batten strips. When the door is fully closed, the intermediate beams shall hang between the two fabric door panels thus pulling the fabric tight and forcing the fabric against the weather seals of the vertical guides. The tension created in the fabric panels shall stabilize the intermediate beams.

The safety arrestors are attached to each end of the bottom beam and are guided in the vertical guide tracks. The safety arrestors will immediately stop the downward movement of the door in case of

belt/cable failure.

Electrical Operation: When the door is completely opened it shall stop on the primary top limit switch. In case of failure, a secondary limit switch shall cut off the drive unit's motor current to prevent the door from overtravel. These two limit switches shall be activated by the uppermost intermediate beam. The drive unit's motor shall be stopped by the slack belt/cable breakers when the door is closed. The slack breakers shall also stop the door in case of belt/cable rupture or if an obstruction should prevent the door from being closed. The slack breakers shall be activated by weight or springs. The door operation shall be controlled by three buttons marked "Open", "Close", and "Stop". They shall be controlled by momentary contact pressure to open and constant pressure to close. Removing the pressure from the close button shall stop the motor drive and set the brake. The mullion operation shall be controlled by two buttons marked "Horizontal Position" and "Vertical Position". Both buttons shall be controlled by constant pressure to open and to close. Removing the pressure from either button shall stop the motor drive and set the brake. The door manufacturer shall provide a NEMA approved enclosure which is factory wired and equipped with instantaneous overload relay. The control panel shall accept a 120v signal from the manual transfer switch. This signal will initiate an automatic sequence mode for sequential door operation.

PART 3 - EXECUTION

EXAMINATION

Examine installed work by other trades prior to door installation.

Verify that openings comply with indicated requirements for type, size, location, and have been installed with plumb jambs and level heads.

Do not proceed with installation until unsatisfactory conditions have been corrected.

PREPARATION

Cleaning: After Fabrication: Clean all metal surfaces thoroughly of all mil scale, rust, oil, grease and other foreign substances. Apply rust-preventive compound to all steel machine-finished parts immediately after cleaning.

Shop Painting: After cleaning, coat with primary paint all steel surfaces other than machine-finished parts. Keep paint off finished bearing surfaces. Before assembly, prime surfaces that will be inaccessible after assembly. Handle painted material with care to avoid scraping or breaking the protective film.

Preparation: Do not erect door until the work of other trades in preparing the opening has been completed and the hangar roof is completed and under full dead load. The structural steel erection subcontractor shall adjust the collateral steel for the door to the proper line, gage, and elevation in accordance with the approved tolerances on the drawings. Bring any discrepancies in the prepared opening to the attention of the General Contractor before beginning the door installation. The General Contractor is totally

responsible for the form, fit and function of the finished product.

ERECTION AND INSTALLATION

Erect and install doors in accordance with manufacturer's instructions.

Building Power: If permanent electrical power is not available when the door is being installed, the General Contractor shall make provision for and obtain a temporary source of electrical power to allow the door manufacturer to install, test and adjust the door under power.

Electrical: All conduit, wire junction boxes, accessories, and all labor to wire and connect to and between all electrical equipment on or for the door shall be installed in accordance with the door manufacturer's approved wiring diagrams and as shown on Electrical Drawings. The electrical control equipment shall be furnished by the door manufacturer. All conduit, wire accessories, fused disconnect switches, and labor shall be supplied by the Electrical Contractor. The electrical wiring of the door shall be coordinated with the installer during installation.

Assembly: Assemble and install the doors and accessories in accordance with reviewed shop drawings. After erection is complete and before field painting is started, thoroughly clean all abraded surfaces, field welds, and field bolts; coat with primer paint.

CLEANING AND TESTING

Cleaning: Clean doors after erection on both interior and exterior.

Testing: Immediately after the door installation is completed, the door manufacturer or his representative shall perform a complete operating test in the presence of the Contracting Officer and Architect. Correct all defects disclosed by the test. Re-test the doors and adjust until the entire installation is fully operable and acceptable.

A training session shall be provided for the door operating personnel and maintenance department. The training shall outline door operation, trouble-shooting, and repair guidelines.

END OF SECTION 08370

SECTION 08410 - ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Division 1 Specification sections, apply to work of this Section.

SUMMARY

Extent of aluminum entrances, storefronts and windows is indicated on drawings and schedules.

Aluminum entrance and storefront types required for the project include:

- Exterior entrance and vestibule doors. (Kawneer 350)
- Frames for exterior entrances. (Kawneer Tri-Fab 451T)
- Frames for interior doors. (Kawneer Tri-Fab II 450)
- Windows at masonry walls and clerestory. (Kawneer Tri-Fab 451T)

Glazing: Refer to "Glass and Glazing" section of Division 8 for glazing requirements for aluminum entrances and storefronts, including doors specified to be factory pre-glazed.

Lock cylinders are specified in the Division-8 hardware section.

SYSTEM DESCRIPTION

Performance Requirements: Provide aluminum entrance, storefront and window assemblies that comply with specified performance characteristics. Each system shall be tested by a recognized testing laboratory or agency in accordance with specified test methods. Provide certified test results.

Thermal Movement: Provide systems capable of withstanding thermal movements resulting from an ambient temperature range of 120 degrees F (67 degrees C), that could cause a metal surface temperature range of 180 degrees F (100 degrees C) within the framing system.

Wind Loading: Provide assemblies capable of withstanding a uniform test pressure of 30 psf inward and 30 psf outward when tested in accordance with ASTM E 330.

Fixed Framing Transmission Characteristics: Provide assemblies that comply with requirements indicated for transmission characteristics.

Air Infiltration: Provide framing system with an air infiltration rate of not more than 0.06 CFM per square foot of fixed area (excluding operable door edges) when tested in accordance with ASTM E 283 at an inward test pressure differential of 1.57 psf.

Water Penetration: Provide framing systems with no water penetration (excluding operable door

edges) as defined in the test method when tested in accordance with ASTM E 331 at an inward test pressure differential of 7.5 psf.

Condensation Resistance: Provide units tested for thermal performance in accordance with AAMA 1503 showing condensation resistance factor (CRF) of not less than 45.

Aluminum Entrance Transmission Characteristics: Provide entrance doors with jamb and head frames that comply with requirements indicated for transmission characteristics.

Air Infiltration: Provide doors with an air infiltration rate of not more than 0.50 CFM for single doors and 1.0 for pairs of doors when tested in accordance with ASTM E 283 at an inward test pressure differential of 1.567 psf.

SUBMITTALS

Product Data: Submit manufacturer's specifications, technical product data, standard details, and installation recommendations for each type of entrance, storefront and window product required. Include the following information:

- Fabricating methods.
- Finishing.
- Hardware.
- Accessories.
- Recommendations for maintenance and cleaning.

Shop Drawings: Submit shop drawings for fabrication and installation of entrances and storefronts, including the following:

- Elevations.
- Detail sections of typical composite members and sill conditions.
- Hardware mounting heights.
- Anchorage and reinforcements.
- Expansion and contraction provisions.
- Glazing details.

Samples: Submit pairs of samples of each type and color of aluminum finish, on 12" long sections of extrusions or formed shapes and on 6" square sheets. Where color or texture variations are anticipated, include 2 or more units in each set of samples indicating extreme limits of variations.

Certification: Provide certified test results showing that systems have been tested by a recognized testing laboratory or agency and comply with specified performance characteristics.

QUALITY ASSURANCE

Single-Source Responsibility: Provide entrance, storefront and window systems produced by a single

manufacturer capable of showing prior production of units similar to those required.

Manufacturer's Qualifications: Provide systems produced by a single manufacturer with not less than 3 years successful experience in the fabrication of assemblies of the type and quality required.

Installer's Qualifications: Systems shall be installed by a firm that has not less than 5 years successful experience in the installation of systems similar to those required.

Design Criteria: Drawings are based on one manufacturer's entrance and storefront system. Another manufacturer's system of a similar and equivalent nature will be acceptable when, in the Contracting Officer's sole judgment, differences do not materially detract from the design concept or intended performance.

PROJECT CONDITIONS

Field Measurements: Check openings by field measurement before fabrication to ensure proper fitting of work; show measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the work. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide products equal to the following:

Amarlite/Arco Metals Co.
Kawneer Company Inc.
U.S. Aluminum Corp., International Alum. Corp.

MATERIALS

Aluminum Members: Provide alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221 for extrusions, and ASTM B 209 for sheet or plate.

Major portions of doors and frames shall be minimum 0.080 inches thick. Extrusions shall be 6063-T5.

Carbon steel reinforcement of aluminum framing members shall comply with ASTM A 36 for structural shapes, plates and bars, ASTM A 611 for cold rolled sheet and strip, or ASTM A 570 for hot rolled sheet and strip.

Fasteners: Provide fasteners of aluminum, nonmagnetic stainless steel, or other material warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors and other

components.

Reinforcement: Where fasteners screw-anchor into aluminum members less than 0.080" thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard noncorrosive pressed-in splined grommet nuts.

Exposed Fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For the application of hardware, use fasteners that match the finish of member or hardware being fastened.

Provide Phillips flat-head machine screws for exposed fasteners.

Aluminum Breakmetal: Provide anodized aluminum breakmetal, minimum thickness 0.040" thick, configuration as detailed and as required. Color shall match aluminum frame.

Concealed Flashing: Provide 26-gage minimum dead-soft stainless steel, or 0.026" minimum extruded aluminum of alloy and type selected by manufacturer for compatibility with other components.

Brackets and Reinforcements: Where feasible, provide high-strength aluminum brackets and reinforcements; otherwise, provide nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A 386.

Concrete/Masonry Inserts: Provide concrete and masonry inserts fabricated from cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 386.

Compression Weatherstripping: Provide the manufacturer's standard replaceable compression weatherstripping gaskets of molded neoprene complying with ASTM D 2000 or molded PVC gaskets complying with ASTM D 2287.

Glass and Glazing Materials: Glass and glazing materials shall comply with requirements of "Glass and Glazing" section of these specifications.

COMPONENTS

Framing System: Provide window, storefront and entrance framing systems fabricated from extruded aluminum members of sizes and profiles indicated.

Provide for flush glazing storefront from the exterior without projecting stops with provisions for glass replacement.

Shop-fabricate and preassemble frame components where possible. Provide storefront frame sections without exposed seams.

Mullion Configurations: Mullions and horizontals shall be one piece. Make provision to drain moisture accumulation to the exterior.

Internal Reinforcement: Provide steel reinforcing within aluminum members as recommended by manufacturer to meet specified design criteria.

Connections: Where movement should be expected, provide slip-joint linings of sheets, pads, shims or washers of fluorocarbon resin or similar material recommended by manufacturer.

Aluminum Door Frames: Fabricate tubular and channel frame assemblies, as indicated, with welded or mechanical joints in accordance with manufacturer's standards; reinforce as necessary to support required loads.

Stile-and-Rail Type Aluminum Doors:

Frame: Provide tubular frame members, fabricated with mechanical joints using heavy inserted reinforcing plates and concealed tie-rods or j-bolts.

Design: Provide 1-3/4" thick doors of design indicated, medium stile.

Glazing: Fabricate doors to facilitate replacement of glass or panels, without disassembly of stiles and rails. Provide snap-on extruded aluminum glazing stops, with exterior stops anchored for non-removal.

HARDWARE

General: Refer to hardware section in Division-8 for requirements for hardware items other than those indicated to be provided by the aluminum entrance manufacturer.

Provide manufacturer's heavy-duty hardware units as indicated, scheduled, or required for operation of each door, including the following items of sizes, number, and type recommended by manufacturer for service required; finish to match door or as indicated otherwise.

Exit Device Dogging: Except on fire-rated doors, or Exit-only doors wherever closers are provided on doors equipped with exit devices, equip the units with keyed dogging device to hold the push bar down and the latch bolt in the open position.

Refer to Hardware Schedule for Aluminum Entrances at end of this section for hardware requirements.

FABRICATION

General: Sizes of door and frame units, and profile requirements, are indicated on drawings.

Thermal-Break Construction: Fabricate window and storefront framing system with an integrally concealed, low-conductance thermal barrier, located between exterior materials and exposed interior members to eliminate direct metal-to-metal contact. Use manufacturer's standard construction that has

been in use for similar projects for period of not less than 3 years.

Prefabrication: Before shipment to the project site, complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible. Disassemble components only as necessary for shipment and installation.

Preglaze door and frame units to greatest extent possible.

Do not drill and tap for surface-mounted hardware items until time of installation at project site.

Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.

Welding: Comply with AWS recommendations; grind exposed welds smooth and restore mechanical finish.

Reinforcing: Install reinforcing as required for hardware and necessary for performance requirements, sag resistance and rigidity.

Dissimilar Metals: Separate dissimilar metals with zinc chromate primer, bituminous paint, or other separator that will prevent corrosion. Do not use coatings containing lead.

Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.

Uniformity of Finish: Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample pair submittal.

Fasteners: Conceal fasteners wherever possible.

Weatherstripping: For exterior doors, provide compression weatherstripping against fixed stops; at other edges, provide sliding weatherstripping retained in adjustable strip mortised into door edge.

Provide EPDM or vinyl blade gasket weatherstripping in bottom door rail, adjustable for contact with threshold.

FINISHES

General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designation of finishes.

Color Anodized Finish: Provide NAAMM AA-M12C22A42/A44, Class I (nonspecular as fabricated mechanical finish; chemical etch, medium matte; minimum thickness 0.7 mil) integrally or electrolytically deposited colored anodic coating complying with AAMA 606.1 or AAM 608.1.

Color: As shown on the plan.

PART 3 - EXECUTION

INSTALLATION

Comply with manufacturer's instructions and recommendations for installation.

Set units plumb, level, and true to line, without warp or rack of framing members, doors, or panels. Provide proper support and anchor securely in place.

Separate aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at point of contact with other materials.

Drill and tap frames and doors and apply surface mounted hardware items, complying with hardware manufacturer's instructions & template requirements. Use concealed fasteners wherever possible.

Set sill members and other members in bed of sealant as indicated, or with joint fillers or gaskets as indicated to provide weathertight construction. Comply with requirements of Division 7 for sealants, fillers, and gaskets.

Refer to "Glass and Glazing" section of Division 8 for installation of glass and other panels shown to be glazed into doors and framing, and not preglazed by manufacturer.

ADJUSTING

Adjust operating hardware to function properly, for smooth operation without binding, and for weathertight closure.

CLEANING

Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.

Clean glass surfaces after installation, complying with requirements contained in the "Glass and Glazing" section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

PROTECTION

Institute protective measures required throughout the remainder of the construction period to ensure that aluminum entrances and storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

HARDWARE SCHEDULE FOR ALUMINUM ENTRANCES

Set Each door shall have:

1½ pr. Butts 4½ X 4 -US10B NRP (Equal to "STANLEY" #FBB 168).

1 Exit Device equal to "ADAMS RITE" Series 8600 x keyed Cylinder deg.- finish to match doors. Function - 01 (Rim Type Device - Exit only). Locate centerline of Exit Device on door at 41" A.F.F.

1 Overhead Surface Closer equal to "LCN" #4040H Super Smoothee with "Cush-N-Stop," extra-duty arm with selective on/off hold-open features and parallel arm mounting. KPD Dark Finish.

1 Aluminum Threshold equal to "PEMKO" #169A X width of door opening.

1 set Weatherstripping including Sweep Strip at bottom of doors, finish to match doors.

END OF SECTION 08410

SECTION 08710 - FINISH HARDWARE

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Division 1 Specification sections, apply to the work of this section.

DESCRIPTION OF WORK:

Definition: "Finish Hardware" includes items known commercially as finish hardware which are required for swing, sliding and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.

Extent of finish hardware required is indicated on drawings and in schedules.

Types of finish hardware required include the following:

- Hinges
- Lock cylinders and keys
- Lock and latch sets
- Bolts
- Exit devices
- Closers
- Overhead holders
- Miscellaneous door control devices
- Door trim units
- Weatherstripping for exterior doors
- Thresholds
- Smoke Gaskets

Thresholds for aluminum entrance doors are specified with entrance doors elsewhere in Division 8.

Cabinet hardware is specified in Division 6.

QUALITY ASSURANCE:

Manufacturer: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from only one manufacturer, although several may be indicated as offering products complying with requirements.

Supplier: A recognized architectural finish hardware supplier, with warehousing facilities, who has been furnishing hardware in the project's vicinity for a period of not less than 2 years, and who is, or who employs an experienced architectural hardware consultant who is available, at reasonable times during the

course of the work, for consultation about project's hardware requirements, to Government, Contracting Officer and Contractor.

Fire-Rated Openings: Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80 and local building code requirements. Provide only hardware which has been tested and listed by UL or FM for types and sizes of doors required and complies with requirements of door and door frame labels.

SUBMITTALS

Product Data: Submit manufacturer's technical product data for each item of hardware in accordance with Division-1 section "Submittals." Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish.

Hardware Schedule: Submit final hardware schedule in manner indicated below. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function and finish of hardware.

Final Hardware Schedule Content: Based on finish hardware indicated, organize hardware schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:

Type, style, function, size and finish of each hardware item.

Name and manufacturer of each item.

Fastenings and other pertinent information.

Location of hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.

Explanation of all abbreviations, symbols, codes, etc., contained in schedule.

Mounting locations for hardware.

Door and frame sizes and materials.

Keying information.

Submittal Sequence: Submit schedule at earliest possible date particularly, where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames) which is critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by finish hardware, and other information essential to the coordinated review of hardware schedule.

Keying Schedule: Submit separate detailed schedule indicating clearly how the Government's final instructions on keying of locks has been fulfilled.

Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.

PRODUCT HANDLING:

Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.

Inventory hardware jointly with representative of the hardware supplier and the hardware installer until each is satisfied that the count is correct.

Provide secure lock-up for hardware delivered to the project, but not yet installed. Control handling and installation of hardware items which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

PART 2 - PRODUCTS

SCHEDULED HARDWARE:

Requirements for design, grade, function, finish, size and other distinctive qualities of each type of finish hardware is indicated in the Finish Hardware Schedule at the end of this section. Products are identified by using hardware designation numbers of the following:

Manufacturer's Product Designations: One or more manufacturers are listed for each hardware type required. Provide either the product designated, or, where more than one manufacturer is listed, the comparable product of one of the other manufacturers which comply with requirements including those specified elsewhere in this section. All hardware shall comply with the Uniform Federal Accessibility Standards (UFAS).

MATERIAL AND FABRICATION:

General:

Hand of Door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for the applicable hardware units by applicable ANSI A156 series standard for each

type hardware item and with ANSI A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.

Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.

Provide concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex screw fasteners.

Tools and Maintenance Instructions for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Government's continued adjustment, maintenance, and removal and replacement of finish hardware.

HINGES, BUTTS AND PIVOTS:

Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template produced units.

Screws: Furnish Phillips flat-head or machine screws for installation of units, except furnish Phillips flat-head or wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.

Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

Steel Hinges: Steel pins.

Non-ferrous Hinges: Stainless steel pins.

Exterior Doors: Non-removable pins.

Interior Doors: Non-rising pins.

Tips: Flat button and matching plug, finished to match leaves.

Number of hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for

doors 90" or less in height and one additional hinge for each 30" of additional height.

LOCK CYLINDERS AND KEYING:

General: Supplier shall meet with Contracting Officer or designated representative to finalize keying requirements and obtain final instructions in writing.

Standard System: Except as otherwise indicated, provide new masterkey system on a 10-N keyway for project.

Equip locks with manufacturer's special 6-pin tumbler cylinder, with construction master key feature, which permits voiding of construction keys without cylinder removal.

Manufacturer: Subject to compliance with requirements, provide products of one of the following:

Bestlock system standard for Selfridge ANG Base, Michigan.

Metals: Construct lock cylinder parts from brass/bronze, stainless steel or nickel silver.

Comply with the Government's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.

Permanently inscribe each key with number or lock that identifies cylinder manufacturer key symbol, and notation "U.S. GOVERNMENT DO NOT DUPLICATE."

Key Material: Provide keys of nickel silver only.

Key Quantity: Furnish 5 change keys for each lock; 5 master keys for each master system; and 5 grandmaster keys for each grandmaster system.

Deliver keys directly to Contracting Officer's representative.

Provide key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of the number of locks required for the project.

LOCKS, LATCHES AND BOLTS:

Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set.

Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.

Provide roller type strikes where recommended by manufacturer of the latch and lock units.

Lock Throw: Provide 3/4" minimum throw of latch and locks used on pairs of doors. Comply with UL Requirements for throw of bolts and latch bolts on rated fire openings.

Provide 1/2" minimum throw on other latch and locks.

Provide all locks, latches, etc., with 2-3/4" backsets unless noted otherwise.

Flush Bolt Heads: Minimum of 1/2" diameter rods of brass, bronze or stainless steel, with minimum 12" long rod for doors up to 7'0" in height. Provide longer rods as indicated for doors exceeding 7'0" in height.

Exit Device Dogging: Except on fire-rated doors, wherever closers are provided on doors equipped with exit devices, equip the units with keyed dogging device to hold the push bar down and the latch bolt in the open position.

CLOSERS AND DOOR CONTROL DEVICES:

Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.

Where parallel arms are indicated for closers, provide closer unit one size larger than recommended for use with standard arms.

All closers on exterior doors shall be mounted on the interior face of door.

Provide drop plates or other adapter plates as required at conditions requiring them.

Combination Door Closers and Holders: Provide units designed to hold door in open position under normal usage and to release and automatically close door under fire conditions. Incorporate an integral electromagnetic holder mechanism designed for use with UL listed fire detectors, provided with normally closed switching contacts.

Combination Closer/Holder units with built-in electronic release functions shall be furnished for 24V DC current to match that of smoke detector/fire alarm system.

Connect into smoke detector/fire alarm system furnished and installed by Electrical Contractor.

Provide gray resilient parts for exposed bumpers unless indicated otherwise.

WEATHERSTRIPPING:

General: Except as otherwise indicated, provide continuous weatherstripping at each edge of every

exterior door leaf. Provide type, sizes and profiles shown or scheduled. Provide non-corrosive fasteners as recommended by manufacturer for application indicated.

Weatherstripping at Door Bottoms:

Provide threshold consisting of contact type resilient insert and metal housing of design and size shown.

Flexible vinyl wiper or sweep seal strip complying with CS 230-60.

Smoke and Draft Control Gasketing: Provide special silicone rubber gasketing products meeting ASTM E-152 Fire Label Standard and ASTM E-283 Air Infiltration/Smoke and Draft Control Requirements; and equal to "PEMKO" S88D "SILICONSEAL" at head and jambs of all U.L. rated doors on this project.

THRESHOLDS:

General: Except as otherwise indicated provide standard metal threshold unit of type, size and profile as shown or scheduled.

HARDWARE FINISHES:

Provide matching finishes for hardware units at each door or opening, to the greatest extent possible, and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set for color and texture.

Provide finishes which match those established by BHMA or, if none established, match the Contracting Officer's sample.

Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standards, but in no case, less than specified for the applicable units of hardware by referenced standards.

The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI A156.18 "Materials & Finishes Standard," including coordination with the traditional U.S. Finishes shown by certain manufacturers for their products.

PART 3 - EXECUTION

INSTALLATION

FINISH HARDWARE

Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Contracting Officer.

Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division-9 section. Do not install surface-mounted items until finishes have been completed on the substrate.

Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.

ADJUST AND CLEAN:

Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

Clean adjacent surfaces soiled by hardware installation.

FINISH HARDWARE SCHEDULE

Set 1 Aluminum Doors, Frame, and Hardware.
RE: Spec Section 08410 except as follows:

1 Keyed Cylinder US10B (Coordinate with Door Supplier.)

Set 2 Aluminum Doors, Frame and Hardware.
RE: Spec. Section 08410

Set 3 Each door shall have:

1-1/2 pr. Butts FBB 179 5 x 4-1/2 US26D NRP (Stanley)

- 1 Exit Device ED9600L x N2M55-626 (Corbin/Russwin)
- 1 Closer 4040H Super Smoothee with "Cush-N-Stop," arm. (90°). Alum. Dark Finish (LCN).
- 1 Threshold #179 AV x width of door opening. (Pemko)
- 1 set Weatherstripping #303DV (Head & Jambs), (Pemko)
- 1 Door Bottom Sweep Strip #345DV x width of door. (Pemko)

Set 4 Each pair of doors shall have:

- 3 pr. Butts FBB 168 4-1/2" x 4-1/2" US26D (Stanley)
- 2 Exit Devices ED9400A x N110 -626. (Corbin/Russwin)
- 2 sets Top Strike #526F52 and Bottom Strike #463F92 (Corbin/Russwin).
- 2 "Sentronic" Closers 4013-SE Aluminum 24VAC (LCN) Conceal all wiring.
- 2 Wall Stops 407-1/2 - B26D (Ives)
- 4 Kickplates #48 Plastic, 1/8" thick x 10" x 2" L.D.W. (Color as selected.) (Quality) Mount on both sides of doors.
- 2 Silencers - 20
- 1 Smoke Gasket Set

Set 5 Each door shall have:

- 1-1/2 pr. Butts FBB 179 4-1/2" x 4-1/2" US26D (Stanley) (5 x 4-1/2 at doors 3'-6" or wider)
- 1 Classroom Lock ML2255 NSM - 626 (Corbin/Russwin)
- 1 "Sentronic" Closer 4013-SE Aluminum 24VAC (LCN) Conceal all wiring.
- 1 Floor Stop #441 - B26D or Wall Stop #407- 1/2 - B26D (Ives)
- 1 Kickplate #48 Plastic, 1/8" thick x 10" x 2" L.D.W. (Color as selected.) (Quality).
- 3 Silencers - 20
- 1 Smoke Gasket Set

Set 6 Each door shall have:

- 1-1/2 pr. Butts FBB 179 4-1/2" x 4-1/2" US26D (Stanley) (FBB168 at all doors over 36" wide).
- 1 Classroom Lock ML2255 NSM - 626 (Corbin/Russwin)
- 1 Closer 4040 Aluminum (LCN) .
- 1 Floor Stop #441 - B26D (Ives)
- 1 Kickplate #48 Plastic, 1/8" thick x 10" x 2" L.D.W. (Color as selected.) (Quality).
- 3 Silencers - 20
- 1 Smoke Gasket Set

Set 7 Each door shall have:

- 1-1/2 pr. Butts FBB 179 4-1/2" x 4-1/2" US26D (Stanley)
- 1 Office Lock ML2251 NSM - 626 (Corbin/Russwin)

- 1 Wall Stop #407- ½ - B26D (Ives)
- 1 Kickplate #48 Plastic, 1/8" thick x 10" x 2" L.D.W. (Color as selected.) (Quality).
- 3 Silencers - 20

Set 8 Each door shall have:

- 1-1/2 pr. Butts FBB 179 4-½ x 4-½ US26D NRP (Stanley) (Note: Provide 2 pr. of butts at doors 7'-6" in height or greater.)
- 1 Storeroom Lock ML2257 NSM - 626 (Corbin/Ruswin) NOTE: Provide Blank Cylinder in lock at all doors into Room 1 from exterior. Keyed Cylinders elsewhere.
- 1 Closer 4040H Super Smoothee with "Cush-N-Stop" arm 90° KPD Dark Finish (LCN)
- 1 Kickplate #48 Plastic, 1/8" thick x 10" x 2" L.D.W. (Color as selected.) (Quality).
- 1 Threshold #169A x width of door opening. (Pemko)
- 1 set Weatherstripping #303DV (Head & Jambs) (Pemko)
- 1 Door Bottom Drip Cap/Sweep strip #3452 DV x width of doors. (Pemko)

Set 9 Each pair of doors shall have:

- 3 pr. Butts FBB179 4-½ x 4-½ US26D (Stanley)
- 1 Storeroom Lock ML2257 NSM-626 (Corbin/Ruswin)
- 1 set Self-Latching Flush Bolts #356 B26D with #489 B26D Dust Proof Strike (Ives)
Mount in inactive door leaf.
- 1 Coordinator #469 - ½ x B26 (Ives)
- 2 "Sentronic" Closers 4013-SE Aluminum 24VAC (LCN) Conceal all wiring.
- 2 Armor Plates #48 Plastic, 1/8" thick x 36" x 2" L.D.W. (Color as selected.) (Quality).
- 3 Silencers - 20 (Ives)
- 1 Smoke Gasket Set

Set 10 Each pair of doors shall have:

- 3 pr. Butts FBB179 4-½ x 4-½ US26D NRP (Stanley)
- 1 Mortised Lockset ML2257 GRC with keyed cylinder - 626 (Corbin-Russwin)
- 1 set Extension Flush Bolts #458 - ½ B26D (Ives) 12" long top and bottom rods.
(Mount in LHR inactive door leaf.)
- 2 Closers #4040H Super Smoothee with "Cush-N-Stop", extra duty arms with selective on/off hold-open feature and parallel arm mounting. Alum. Finish. (LCN) 90°
- 1 Kickplate #48 Plastic, 1/8" thick x 10" x 2" L.D.W. (Color as selected) (Quality)
- 1 Threshold #169A x width of door opening. (Pemko)
- 1 set Weatherstripping #303DV (Head & Jambs) (Pemko)
- 2 Door Bottom Drip Cap/Sweep Strip #3452DV x width of doors. (Pemko)
- 1 set Split astragal brush weatherstripping #18041DP x height of doors. (Pemko)

Set 11 Each door shall have:

- 1- ½ pr. Butts FBB179 4-½ x 4-½ US26D (Stanley) (5 x 4-½ at doors 3'-6" or wider)
- 1 Passage Latch ML2210 NSM-626 (Corbin/Russwin)
- 1 Closer #4041 Alum. Finish. (LCN)
- 1 Wall Stop #407-1/2 x B26D or Floor Stop 436 x 435-B26D (Ives)
- 1 Kickplate #48 Plastic, 1/8" thick x 10" x 2" L.D.W. (Color as selected). (Quality).
- 3 Silencers - 20 (Ives)
- 1 Smoke Gasket Set.

Set 12 Each pair of doors shall have:

- 3 pr. Butts FBB168 4-½ x 4-½ US26D (Stanley)
- 2 Electro-Magnetic Locks #280-MBS (Stanley)
- 2 Smart Bars #690-36-628 (Locknetics)
- 2 Door Cords #788C-16 (Locknetics)
- 1 Power Supply #510-DCM1-SBP2 (Locknetics) 24VDC (Verify with E.C.)
- 1 #770 Series Smart Entry Access Control System with heavy-duty weatherproof digital keypad in cast stainless steel housing and Controller package installed Separate of the keypad. (Locknetics) 24VAC/DC (Verify with E.C.).
- 2 Door Pulls 8103-0 x S32D (Ives)
- 2 Closers #4040H Alum. Finish (LCN)
- 2 Wall Stops 407-½ - B26D (Ives)
- 4 Kickplates #48 Plastic, 1/8" thick x 10" x 2" L.D.W. (Color as selected) (Quality)
Mount on both sides of doors.
- 2 Silencers - 20

Set 13 Each door shall have:

- 1-½ pr. Butts FBB179 4-½ x 4-½ US26D (Stanley)
- 1 Storeroom Lock ML2257 NSM-626 (Corbin/Russwin)
- 1 “Sentronic” Closer 4013-SE Aluminum 24VAC (LCN) Conceal all wiring.
- 1 Wall Stop 407-½ - B26D (Ives)
- 1 Armor Plate #48 Plastic, 1/8" thick x 36" x 2" L.D.W. (Color as selected) (Quality)
- 3 Silencers-20
- 1 Smoke Gasket Set

Set 14 Each door shall have:

- 1-½ pr. Butts FBB 179 4-½" x 4-½" US26D (Stanley)
- 1 Exit Device ED9600AL x N2M55-626 (Corbin/Russwin).
- 1 #770 Series Smart Entry Access Control System with heavy-duty weatherproof digital keypad in cast stainless steel housing and Controller package installed separate of the keypad. (Locknetics). 24 VAC/VDC (Verify with E.C.)
- 1 #712-75 Electric Strike (Stainless Steel) For fail-secure operation and compatible with Mortise-type Exit Device. (Folger Adam Co.) Verify electrical requirements with E.C.
- 1 Power Supply #505 24 DC (Locknetics) Verify with E.C.
- 1 Closer #4040H Aluminum (LCN)
- 1 Floor Stop 441- B26D (Ives)
- 1 Kickplate #48 Plastic, 1/8" thick x 10" x 2" L.D.W. (Color as selected) (Quality)
- 3 Silencers - 20
- 1 Smoke Gasket Set

END OF SECTION 08710

SECTION 08800 - GLASS AND GLAZING

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

Extent of glass and glazing work is indicated on drawings and schedules.

Types of work in this section include glass and glazing for:

- Windows.
- Storefront construction.
- Entrances and other doors.
- Sidelights, borrowed lights and other openings.
- Mirror glass.
- Sealed insulating spandrel units.

SYSTEM DESCRIPTION

Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.

Normal thermal movement is defined as that resulting from an ambient temperature range of 120 degrees F (67 degrees C) and from a consequent temperature range within glass and glass framing members of 180 degrees F (100 degrees C).

Deterioration of insulating glass is defined as failure of hermetic seal due to other causes than breakage which results in intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coating, if any, resulting from seal failure, and any other visual evidence of seal failure or performance.

Deterioration of coated glass is defined as the development of manufacturing defects including peeling, cracking or other indications of deterioration in coating due to normal conditions of use.

SUBMITTALS

Product Data: Submit manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions. **Samples:** Submit, for verification purposes, 12" square samples of each type of glass indicated except for clear single pane units, and 12" long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative of adjoining framing system in color.

Samples: Submit, for verification purposes, 12" square samples of each type of glass indicated except for clear single pane units, and 12" long samples of each color required for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative of adjoining framing system in color.

Certificate: Submit certificates from respective manufacturers attesting that glass and glazing materials furnished for project comply with requirements.

Separate certification will not be required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authorities having jurisdiction.

QUALITY ASSURANCE

Glazing Standards: Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or other referenced standards.

Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials.

Fire Resistance Rated Wire Glass: Provide wire glass products that are identical to those tested per ASTM E 163 (UL 9) and are labeled and listed by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.

Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component pane of units with appropriate certification label of inspecting and testing organization indicated below:

Insulating Glass Certification Council (IGCC).

Associated Laboratories, Inc. (ALI).

Single Source Responsibility for Glass: To ensure consistent quality of appearance and performance,

provide materials produced by a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source for each type and class required.

DELIVERY, STORAGE, AND HANDLING

Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes.

PROJECT CONDITIONS

Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other causes.

WARRANTY

General: Warranties shall be in addition to, and not a limitation of, other rights the Government may have under the Contract Documents.

Manufacturer's Special Project Warranty on Insulating Glass: Provide written warranty signed by manufacturer of insulating glass agreeing to furnish f.o.b. point of manufacture, freight allowed project site, within specified warranty period indicated below, replacements for those insulating glass units developing manufacturing defects. Manufacturing defects are defined as failure of hermetic seal of air space (beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coatings, if any, and other visual indications of seal failure or performance.

Warranty Period: Manufacturer's standard but not less than 10 years after date of substantial completion.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products of one of the following:

Manufacturers of Clear and Tinted Float Glass:

Ford Glass Division.
Guardian Industries Corp.
LOF Glass, Inc.

PPG Industries, Inc.
ITI Industries.

Manufacturers of Wire Glass:

Guardian Industries Corp.
Hordis Brothers, Inc.
Pilkington Sales (North America) Limited.

Manufacturers of Heat-Treated Glass:

Ford Glass Division.
Guardian Industries Corp.
LOF Glass, Inc.
PPG Industries, Inc.
ITI Industries.

Manufacturers of Insulating Glass:

Ford Glass Division.
Guardian Industries Corp.
PPG Industries, Inc.
ITI Industries.

GLASS PRODUCTS, GENERAL

Primary Glass Standard: Provide primary glass which complies with ASTM C 1036 requirements, including those indicated by reference to type, class, quality, and, if applicable, form, finish, mesh and pattern.

Heat-Treated Glass Standard: Provide heat-treated glass which complies with ASTM C 1048 requirements, including those indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish, and pattern.

Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.

PRIMARY GLASS PRODUCTS

Clear Float Glass: Type I (transparent glass, flat), Class 1 (clear), Quality q³ (glazing select).

Tinted Float Glass: Type I (transparent glass, flat), Class 2 (tinted heat absorbing and light reducing), Quality q³ (glazing select), and as follows:

Match color of exterior pane of insulating glass.

Refer to requirements for sealed insulating glass units for performance characteristics of assembled units composed of tinted glass, coated or uncoated, relative to visible light transmittance, U-values, shading coefficient and visible reflectance.

Wired Glass: Type II (patterned and wired glass, flat), Class 1 (translucent), Quality q⁸ (glazing); complying with ANSI Z97.1; 1/4" thick; of form and mesh pattern indicated below.

Polished Wire Glass: Form 1 (wired, polished both sides), Mesh m2 (square).

Mirror Glass: 1/4" thick, Type I, Class 1, Quality q², conforming to FS DD-G-451, with silvering, copper coating, and protective organic coating complying with FS DD-M-411.

Provide mirror glass at locations shown on drawings. Edges shall be polished where no frames are indicated.

HEAT-TREATED GLASS PRODUCTS

Manufacturing Process: Manufacture heat-treated glass as follows:

By vertical (tong-held) or horizontal (roller hearth) process, at manufacturer's option, except provide horizontal process "tongless" or "free of tong marks."

Glass with visual distortions shall not be used and will not be accepted.

Uncoated Clear Heat-Treated Float Glass: Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q³ (glazing select), kind as indicated below.

Kind FT (fully tempered) where indicated.

Uncoated Tinted Heat-Treated Float Glass: Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 2 (tinted heat absorbing and light reducing), Quality q³ (glazing select), with tint color and performance characteristics for 1/4" thick glass matching those indicated for non-heat-treated tinted float glass; kind as indicated below:

Kind FT (fully tempered).

SEALED INSULATING GLASS UNITS

General: Provide pre-assembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E 774 for performance classification indicated as well as with other requirements specified for glass characteristics, air space, sealing system, sealant, spacer material, corner design and dessicant.

For properties of individual glass panes making up units, refer to product requirements specified elsewhere in this section applicable to types, classes, kinds and conditions of glass products indicated.

Provide heat-treated panes of kind and at locations indicated or, if not indicated, provide heat-strengthened panes where recommended by manufacturer for application indicated and tempered where indicated or where safety glass is designated or required.

Performance Classification per ASTM E 774: Class A.

Thickness of Each Pane: 1/4" unless otherwise indicated.

Air Space Thickness: 1/2".

Sealing System: Dual seal; primary and secondary sealant; manufacturer's standard materials.

Spacer Material: Aluminum.

Dessicant: Manufacturer's standard; either molecular sieve or silica gel or blend of both.

Corner Construction: Manufacturer's standard corner construction.

Uncoated Insulating Glass Units: Manufacturer's standard units complying with the following requirements:

Exterior Pane: Tinted float glass, bronze.

Kind FT (fully tempered).

Interior Pane of Glass: Clear float glass, except obscure glass at locations shown on drawings.

Kind FT (fully tempered).

Performance Characteristics: Visible light transmittance of 45 percent; summer U-value of .57 at 1/2" air space; winter U-value of .49 at 1/2" air space. Shading coefficient of 0.55 and outdoor reflectance of visible light of 8 percent.

SEALED INSULATING SPANDREL UNITS

Ceramic-Coated Heat-Treated Spandrel Glass: Condition B (spandrel glass, one surface ceramic coated), Type I (transparent glass, flat), Class 1 (clear), Quality q³ (glazing select), with ceramic coating applied to second surface and third surface of insulating spandrel panels and complying with the following requirements:

Kind HS (heat strengthened).

Color: Match color of insulating glass; submit samples for Architect's selection and approval.

Fallout Resistance: Provide spandrel units identical to those passing fall out resistant test for spandrel glass specified in ASTM C1048.

Thickness of Each Panel: 1/4".

Air Space Thickness: 1/2".

Exterior Pane: Ceramic coating applied to second surface.

Interior Pane: Ceramic coating applied to third surface.

ELASTOMERIC GLAZING SEALANTS AND PREFORMED GLAZING TAPES

General: Provide products of type indicated and complying with the following requirements:

Compatibility: Select glazing sealants and tapes of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.

Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.

Colors: Provide color of exposed sealants as selected by Architect from manufacturer's standard colors.

One-Part Acid-Curing Silicone Glazing Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to uses indicated, O.

One-Part Non-Acid-Curing Silicone Glazing Sealant: Type S, Grade NS, Class 25, Uses NT, G, A, and, as applicable to uses indicated, O; and complying with the following requirements for modulus and additional joint movement capability.

Medium Modulus: Tensile strength of not less than 45 nor more than 75 psi at 100 percent elongation when tested per ASTM D 412 after 14 days at 77°F (20° C) and 50 percent relative humidity.

Preformed Butyl-Polyisobutylene Glazing Tape: Provide manufacturer's standard solvent-free butyl-polyisobutylene formulation with a solids content of 100 percent; complying with AAMA A 804.1; in extruded tape form; non-staining and non-migrating in contact with nonporous surfaces; packaged on rolls with a release paper on one side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application indicated.

Products: Subject to compliance with requirements, provide one of the following:

One-Part Acid-Curing Silicone Glazing Sealant:

"Chem-Calk 1200"; Bostik Construction Products Div.

"Dow Corning 999"; Dow Corning Corp.

"SCS 1200"; General Electric Corp.

"863"; Pecora Corp.

"Proglaze"; Tremco, Inc.

One-Part Non-Acid Curing Medium-Modulus Silicone Glazing Sealant:

"Dow Corning 795"; Dow Corning Corp.

"Silpruf"; General Electric Corp.

"Gesil"; General Electric Corp.

"Spectrum 2"; Tremco, Inc.

Preformed Butyl-Polyisobutylene Glazing Tape Without Spacer Rod:

"Chem-Tape 40"; Bostick Construction Products Div.

"Extru-Seal"; Pecora Corp.

"Tremco 440 Tape"; Tremco Inc.

Preformed Butyl-Polyisobutylene Glazing Tape With Spacer Rod:

"Chem-Tape 60"; Bostik Construction Products Div.

"Shim-Seal"; Pecora Corp.

"Pre-shimmed Tremco 440 Tape"; Tremco Inc.

MISCELLANEOUS GLAZING MATERIALS

Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.

Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.

Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.

Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.

Compressible Filler Rods: Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5-10 psi compression strength for 25 percent deflection.

PART 3 - EXECUTION

EXAMINATION

Require Glazier to inspect work of glaze framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Obtain Glazier's written report listing conditions detrimental to performance of glazing work. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

PREPARATION

Clean glazing channels and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

GLAZING, GENERAL

Comply with combined printed recommendations of glass manufacturers, of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.

Glazing channel dimensions as indicated in details are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.

Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift

glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance or appearance.

Apply primers to joint surfaces where required for adhesion of sealants.

GLAZING

Install setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6" from corner, unless otherwise required. Set blocks in thin course of sealant which is acceptable for heel bead use.

Provide spacers inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

Provide edge blocking to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.

Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics. Provide compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers, to prevent sealant from extruding into glass channel weep systems and from adhering to joints back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.

Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

Tool exposed surfaces of sealants to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.

Miter cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

PROTECTION AND CLEANING

Protect exterior glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.

Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.

Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less often than once a month, for build-up of dirt, scum, alkali deposits or staining. When examination reveals the presence of these forms of residue, remove by method recommended by glass manufacturer.

Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

Wash glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Wash glass by method recommended by glass manufacturer.

END OF SECTION 08800

SECTION 09255 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

Non-load-bearing steel framing members for gypsum board assemblies.

Gypsum board assemblies attached to steel framing.

One hour fire-resistive ceiling assembly as scheduled.

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

Division 7 Section "Firestopping" for firestopping systems and fire-resistive-rated joint sealants.

DEFINITIONS

Gypsum Board Construction Terminology: Refer to ASTM C 11 USG Systems Folder SA-923, and GA-505 for definitions of terms related to gypsum board assemblies not defined in this Section or in other referenced standards.

SUBMITTALS

Product data for each type of product specified.

QUALITY ASSURANCE

Fire-Test-Response Characteristics: Where fire-rated gypsum board assemblies are indicated, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

Fire Resistance Ratings: As indicated by reference to GA File Numbers in GA-600 "Fire Resistance Design Manual" or to design designations in UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.

Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board

assemblies from a single manufacturer.

Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

DELIVERY, STORAGE, AND HANDLING

Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

PROJECT CONDITIONS

Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.

Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F (10 deg C) for 48 hours prior to application and continuously after until dry. Do not exceed 95 deg F (35 deg C) when using temporary heat sources.

Ventilation: Ventilate building spaces, as required, for drying joint treatment materials. Avoid drafts during hot dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Steel Framing and Furring:

Dale Industries, Inc.
Dietrich Industries, Inc.
Gold Bond Building Products Div., National Gypsum Co.
Unimast Inc.
United States Gypsum Co.

Gypsum Board and Related Products:

Domtar Gypsum.
Georgia-Pacific Corp.
Gold Bond Building Products Div., National Gypsum Co.
United States Gypsum Co.

STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

General: Provide components complying with ASTM C 754 for materials and sizes unless otherwise indicated.

Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

Channels: Cold-rolled steel, 0.05980-inch-minimum thickness of base (uncoated) metal and 7/16-inch-wide flanges, and as follows:

Carrying Channels: 1-1/2 inch deep, 475 lb per 1000 feet, unless otherwise indicated.

Finish: Rust-inhibitive paint.

Steel Rigid Furring Channels: ASTM C 645, hat-shaped, depth of 7/8 inch, and minimum thickness of base (uncoated) metal as follows:

Thickness: 0.0179 inch, unless otherwise indicated.

STEEL FRAMING FOR WALLS AND PARTITIONS

General: Provide steel framing members complying with the following requirements:

Component Sizes and Spacings: As indicated but not less than that required to comply with ASTM C 754 under the following maximum deflection and lateral loading conditions:

Maximum Deflection: $L/240$ at 5 lb per sq. ft.

Protective Coating: Manufacturers standard corrosion-resistant coating.

Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 deg and doubled over to form 3/16-inch-wide minimum lip (return) and complying with the following requirements for minimum

thickness of base (uncoated) metal and for depth:

Thickness: 25 gage, unless otherwise indicated.

Depth: As indicated.

Steel Rigid Furring Channels: ASTM C 645, hat-shaped, depth and minimum thickness of base (uncoated) metal as follows:

Depth: 7/8 inch.

Thickness: 0.0179 inch, unless otherwise indicated.

Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

GYPSUM BOARD PRODUCTS

General: Provide gypsum board of types indicated in maximum lengths available to minimize end-to-end butt joints.

Thickness: Provide gypsum board in thicknesses indicated or, if not otherwise indicated, in 5/8 inch thicknesses to comply with ASTM C 840 for application system and support spacing indicated.

Gypsum Wallboard: ASTM C 36 and as follows:

Type: Type X

Edges: Tapered.

Thickness: 5/8 inch unless otherwise indicated.

TRIM ACCESSORIES

Accessories for Interior Installation: Corner beads, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:

Material: Formed metal, complying with the following requirement:

Sheet steel coated with zinc by hot-dip or electrolytic processes.

Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:

Cornerbead on outside corners, unless otherwise indicated.

LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim unless otherwise indicated. Equal to USG # 200-B metal trim.

U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use U-bead where indicated.

One-piece control joint formed with V-shaped slot, with removable strip covering slot opening.

JOINT TREATMENT MATERIALS

General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.

Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.

Setting-Type Joint Compounds for Gypsum Board: Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated.

Where setting-type joint compounds are indicated as a taping compound only or for taping and filling only, use formulation that is compatible with other joint compounds applied over it.

For prefilling gypsum board joints, use formulation recommended by gypsum board manufacturer for this purpose.

For filling joints and treating fasteners of water-resistant gypsum backing board behind base for ceramic tile, use formulation recommended by the gypsum board manufacturer for this purpose.

For topping compound, use sandable formulation.

Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products complying with the following requirements for formulation and intended use.

Ready-Mixed Formulation: Factory-mixed product.

Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.

Topping compound formulated for fill (second) and finish (third) coats.

ACOUSTICAL SEALANT

Latex Acoustical Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834 and the following requirements:

Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90.

Acoustical Sealant for Concealed Joints: Manufacturer's standard non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.

Products: Subject to compliance with requirements, provide one of the following:

Acoustical Sealant:

AC-20 FTR Acoustical and Insulation Sealant, Pecora Corp.
SHEETROCK Acoustical Sealant, United States Gypsum Co.

Acoustical Sealant for Concealed Joints:

BA-98, Pecora Corp.
Tremco Acoustical Sealant, Tremco, Inc.

MISCELLANEOUS MATERIALS

General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.

Steel drill screws complying with ASTM C 1002 for the following applications:

Fastening gypsum board to steel members less than 0.03 inch thick.

Fastening gypsum board to gypsum board.

Steel drill screws complying with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112 inch thick.

Sound Attenuation Blankets: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing).

Thickness as indicated on drawings.

PART 3 - EXECUTION

EXAMINATION

Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

PREPARATION

Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.

INSTALLING STEEL FRAMING, GENERAL

Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.

Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with "Gypsum Construction Handbook" published by United States Gypsum Co.

Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.

Where building structure abuts ceiling perimeter or penetrates ceiling.

Where partition framing and wall furring abut structure except at floor.

Provide slip- or cushioned-type joints to attain lateral support and avoid axial loading.

Do not bridge building expansion and control joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

INSTALLING STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

Suspend ceiling hangers from building structural members and as follows:

Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members,

install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

Do not attach hangers to metal roof deck. Attach hangers to structural members.

Do not connect or suspend steel framing from ducts, pipes or conduit. Maintain minimum 2 inch clearance between hangers or braces and ducts, pipes or conduit.

Sway-brace suspended steel framing with hangers used for support.

Install suspended steel framing components in sizes and at spacings indicated but not less than that required by the referenced steel framing installation standard.

Wire Hangers: 0.1620-inch (8-gage) diameter, 4 feet o.c.

Carrying Channels (Main Runners): 1-1/2 inch, 4 feet o.c.

Rigid Furring Channels (Furring Members): 16 inches o.c.

Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring members or grid suspension members are level to within 1/8 inch in 12 feet as measured both lengthwise on each member and transversely between parallel members.

Wire-tie or clip furring members to main runners and to other structural supports as indicated.

INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.

Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall.

Where top runners are installed directly against metal deck or structural members, provide deflection track.

Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch from the plane formed by the faces of adjacent framing.

Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Cut studs ½ inch short of full height. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

For fire-resistive-rated partitions requiring partitions to extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.

Refer to Section 07270 for fire-stopping requirements.

Install steel studs and furring in sizes and at spacings indicated but not less than that required by the referenced steel framing installation standard to comply with maximum deflection and minimum loading requirements specified:

Single-Layer Construction: Space studs at 16 inches o.c.

Install steel studs so that flanges point in the same direction and so that leading edges or ends of each gypsum board can be attached to open (unsupported) edges of stud flanges first.

APPLYING AND FINISHING GYPSUM BOARD, GENERAL

Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.

Install sound attenuation blankets where indicated prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

Install ceiling board panels across framing to minimize the number of abutting end joints and avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

Install wall/partition board panels to minimize the number of abutting end joints or avoid them entirely. Stagger abutting end joints not less than one framing member in alternate courses of board. At stairwells and other high walls, install panels horizontally with end abutting joints over studs and staggered.

Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Position adjoining panels so that tapered edges abut tapered edges, and field-cut edges abut field-cut edges and ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions. Avoid joints at corners of framed openings where possible.

Attach gypsum panels to steel studs so that the leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

Attach gypsum panels to framing provided at openings and cutouts.

Form control joints and expansion joints at locations indicated and to comply with manufacturer's recommended spacing, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.

Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chase walls that are braced internally.

Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.

Fit gypsum panels tightly around ducts, pipes, and conduits.

Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4-to-1/2-inch-wide joints to install sealant.

Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4-inch-to-1/2-inch-wide spaces at these locations and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

Where sound attenuation blankets are indicated, seal construction at perimeters, behind control and expansion joints, openings, and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.

GYPSUM BOARD APPLICATION METHODS

Single-Layer Application: Install gypsum wallboard panels as follows:

On ceilings, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.

On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated, and provide panel lengths that will minimize end joints.

Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:

Fasten with screws.

INSTALLING TRIM ACCESSORIES

General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.

Install corner beads at external corners.

Install edge trim where edge of gypsum panels would otherwise be exposed or semi-exposed. Provide edge trim type with face flange formed to receive joint compound except where other types are indicated.

Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.

Install L-bead where edge trims can only be installed after gypsum panels are installed.

Install U-bead where indicated.

Install control joints to comply with manufacturer's recommended spacing and according to ASTM C 840, and in locations approved by Contracting Officer for visual effect.

FINISHING GYPSUM BOARD ASSEMBLIES

General: Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated.

Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.

Apply joint tape over gypsum board joints except those with trim accessories having concealed face flanges not requiring taping to prevent cracks from developing in joint treatment at flange edges.

Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.

Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of

finish is required for fire-resistive-rated assemblies and sound-rated assemblies.

Level 4 for gypsum board surfaces indicated to receive light-textured finishes, wallcoverings, and paints over light textures.

For level 4 gypsum board finish, embed tape in finishing compound plus two separate coats applied over joints, angles, fastener heads, and trim accessories using the following combination of joint compounds (not including prefill), and sand between coats and after last coat:

Embedding and First Coat: Setting-type joint compound.

Fill (Second) Coat: Setting-type joint compound.

Finish (Third) Coat: Ready-mixed, drying-type, all-purpose or topping compound.

Where level 1 gypsum board finish is indicated, apply joint compound specified for embedding coat.

CLEANING AND PROTECTION

Promptly remove any residual joint compound from adjacent surfaces.

Provide final protection and maintain conditions, in a manner suitable to Installer, that ensures gypsum board assemblies remain without damage or deterioration at time of Substantial Completion.

END OF SECTION 09255

09260 - METAL STUD AND GYPSUM BOARD SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Conditions of the Contract and Division 1 apply to this Section.
- B. Provide labor, materials and equipment required to complete gypsum board system work as indicated in the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 06100 - Rough and Finish Carpentry
- B. Section 07920 - Sealant and Caulking
- C. Section 09500 - Acoustical Treatment
- D. Section 09900 – Painting
- E. Division 15000 - Mechanical Access Panels
- F. Division 16000 - Electrical Access Panels
- G. Division 16000 - Lighting

1.3 QUALITY ASSURANCE

- A. Construction Tolerances
 - 1. Do not exceed 1/8" in 8'-0" variation from plumb or level in any exposed line or surface, except at joints between units.
 - 2. Do not exceed 1/16" variation between planes of abutting edges or ends.
- B. Reference Standards
 - 1. ASTM A525 Spec. for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 - 2. ASTM C36 Spec. for Gypsum Wallboard.
 - 3. ASTM C475 Spec. for Joint Treatment Materials for Gypsum Wallboard Construction.

4. ASTM C514 Spec. for Nails of the Application of Gypsum Wallboard.
5. ASTM C557 Spec. for Adhesive for Fastening Gypsum Wallboard to Wood Framing.
6. ASTM C630 Spec. for Water-Resistant Gypsum Backing Board.
7. ASTM C645 Spec. for Non-Load (Axial) Bearing Steel Studs, Runners (Track) and Rigid Furring Channels for Screw Application of Gypsum Board.
8. ASTM C646 Spec. for Steel Drill Screws for the Application of Gypsum Board to Light-Gage Steel Studs.
9. ASTM C754 Spec. for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Wallboard, Backing Board or Water-Resistant Backing Board.
10. ASTM C840 Spec. for Application and Finishing of Gypsum Board.
11. ASTM C894 Spec. for Type W Screws for the Application of Gypsum Board to Wood Framing.
12. ASTM E90 Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions.
13. ASTM E119 Fire Tests of Building Construction and Materials.
14. ASTM E413 Classification for Determination of Sound Transmission Class.
15. ASTM C931 Spec. for Exterior Gypsum Soffit Board.
16. ASTM C1178 Spec. for Glass Mat Water-Resistant Gypsum Backing Board.
17. ANSI A108.9 Test Methods and Specifications for Cementitious Backer Units.

1.4 SUBMITTALS

- A. Refer to Section 01300 for Submittal Requirements.
- B. Texture/Finish Mock-Up
 1. Provide a mock-up area, minimum 8'-0" wide x full height of wall for each texture used on this project. Sample area shall include as a minimum one continuous horizontal joint, one full height vertical joints, and if at a gypsum ceiling, continuous horizontal joint, one full height vertical joint, and if at a gypsum ceiling, continuous intersection with that ceiling to show texture change.

- a. The mock-up may be part of the Work and may be incorporated into the finished work, when so approved by the Contracting Officer.
 - b. Revise as necessary to secure the Contracting Officer's approval.
 - c. The mock-up areas, when approved by the Contracting Officer, will be used as datum points for comparison with the remainder of the finishing work of this Section for the purpose of acceptance or rejection of the work.
2. When making mock-up and throughout finishing of gypsum board, illuminate areas of installation using building's permanent lighting system and temporary additional lights as required; temporary alone will not be acceptable.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the project site with manufacturer's label intact and legible.
- B. Stack wallboard so that long lengths are not over short lengths.
 - C. Store material inside under cover, stacked flat, off floor and away from sweating walls and other damp surfaces.
 - D. Store adhesives, joint finishing compounds, in dry area, provide protection against freezing at all times.
- E. Metal products shall be stored and protected so as to prevent rusting.
 - F. All materials which are rusted, stained, or otherwise damaged during delivery or storage shall be removed from the site and replaced with acceptable material.

1.6 ENVIRONMENTAL CONDITIONS

- A. Maintain a uniform room temperature between 55EF and 70EF one week prior to and during application and until completely dry and occupied. Provide adequate ventilation. Humidity level not to exceed 50% R.H.
- B. Provide ventilation during and following adhesive and joint treatment application. Use temporary air circulators in enclosed areas lacking ventilation.
- C. Under slow drying conditions, allow additional drying time between coats of joint treatment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal "Cee" Studs

1. Cold-formed, galvanized steel.
 - a. Screw type with perforated webs and knurled flanges.
 - b. 25 gauge by size indicated on drawings.
 - c. Provide top and bottom tracks, bridging, and bracing as required and recommended by manufacturer.
2. Provide minimum 20 gauge studs where "Durock" occurs.

B. Suspension and Furring Materials

1. Suspension main channels: 1-1/2" and 3/4" x 16 ga. cold rolled steel, galvanized "C" section. Minimum .475 lbs. per L.F.
2. Hat Furring Channels: Hat Shape sections 20 ga. galvanized steel, 1-3/8" x 7/8" deep, ASTM C645.
3. Provide 18 gauge tie wire and attachment clips as required and recommended by manufacturer. All galvanized finish.
4. Hanger Wire: Soft annealed galvanized mild steel wire - 12 gauge.
5. Resilient Furring Channels: USG RC-1 Semi-Hat Shape sections 20 ga. galvanized steel, 1-3/8" x 7/8" deep, ASTM A568.

C. Gypsum Board

1. Comply with ASTM C36 material specification unless specified otherwise. 48" wide x lengths long as possible or as required, thickness as shown on drawings. Tapered edges.
 - a. Gypsum Board Types:
 - Type "X" at rated applications. USG Firecode "C" or equal.
 - Type "WR" at moist applications. Comply with ASTM C-630.
 - Regular at all other applications.

2. Gypsum Sheathing: USG 1/2" thick gypsum core with weather resistant paper all surfaces.

D. Tile Backer Board

1. U.S.G. "Durock" Tile Backer Board: Aggregated hydraulic cement board with coated woven glass fiber mesh in back and front surfaces.

2. Maximum length and width x thickness called for on drawings.
 3. Glass fiber pressure sensitive tape.
- E. Drywall Fasteners and Attachments
1. Provide screw fasteners of the type and size recommended by manufacturer for gypsum board applications. Type M for metal and Type W for wood attachment. Use coated screws at exterior applications. Use special fasteners provide by manufacturer for Durock applications.
 2. Adhesives: Provide PL 400 at "wet" areas. Provide laminating adhesive as recommended by the manufacturer if so required.
- F. Joint Treatment Materials
1. Joint Tapes: Plain or perforated complying with ASTM C475.
 2. Joint Compound: Adhesive with or without fillers complying with ASTM C475.
 3. Fiberglass joint tape as recommended by the manufacturer for specific applications.
- G. Trim Accessories
1. Standard: Provide standard trim accessories of sizes and shape required for gypsum board applications as shown and required, fabricated from galvanized steel.
 2. Provide extruded aluminum "F" shape window system sill, head and jamb trim as indicated on drawings; dark bronze finish.
- H. Texturing Products
1. USG Spray Texture finish, non-asbestos unaggregated spray texture to produce an "Orange Peel" texture. Non washable unpainted.
- I. Acoustic and Firesafing Insulation
1. U.S. Gypsum Company, "thermafiber" mineral fiber 3 PCF density unfaced insulation. Thickness as shown on drawings.
- J. Miscellaneous
1. Fasteners: Drill in type TEC or Tapcon, Buildex, Rawl, or Phillips.

- a. Do not use powder driven fasteners unless approved by Contracting Officer.
2. Acoustic Sealant: Tremco Acoustic Sealant or equal as approved by the Contracting Officer.
3. Isolation Gasket: Williams Gasket Company, "Everlastic", close cell neoprene stock, thickness 25% greater than joint dimension, width to suit joint conditions.

K. Flush Access Doors

1. JL Industries Model WB for wallboard or approved equal. Gypsum board shall be inset into door recess.
 - a. Door: 14 gal. "steel - prime painted".
 - b. Frame: 16 ga. steel - prime painted, 1" wide flange.
 - c. Hinges: Concealed - spring type to permit 175 degree opening.
 - d. Lock: Hex head operated concealed cam.
 - e. Anchors: As recommended by door manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Metal Stud/Furring Channel Installation

1. Install in strict accordance with USG Company Gypsum Construction Handbook and manufacturer's printed instructions.
2. Studs shall be placed vertically in runner track, spaced as called for on drawings but not greater than:
 - a. 16" o.c. for 1/2" gypsum board and tile backer board.
 - b. 24" o.c. for 5/8" gypsum board.
3. All studs located adjacent to door and frames, partition intersections and corners shall be anchored to runner flanges with metal lock fastener tool. Double studs at door frames and borrowed lights.

4. Where shown, extend metal studs to underside of structure for bracing. Studs extended to deck or structure shall have deep leg track and have space for 1/4" deflection.

5. Walls which are shown to extend above ceiling but not to deck shall have 45E stud braces at 6'-0" O.C. and at each door jamb.

6. Spot grout hollow metal door frame anchors while installing drywall.

7. At one sided "shaft" walls provide horizontal "V" type bracing at 48" o.c. vertically or clip brace metal studs back to masonry wall at 48" o.c. vertically.

8. Furring Channels: Attach furring channels to masonry walls and wood framing where shown. At "Z" shaped furring channels coordinate insulation with insulation trade. Space maximum 16" on center. Add additional furring channels around all openings and penetrations.

9. Resilient Furring Channels: Attach channels to studs where shown. Space maximum 24" o.c. mounting flange down.

B. Metal Framed Soffit System

1. Frame soffits/fascia with specified metal stud members; see drawings. Provide additional suspension members at soffit/fascia penetrations such as lights, diffusers, and access panels.

C. Ceiling System

1. Attach furring channels to wood framing at 16" o.c. maximum with wood screws.

2. Provide additional suspension channels and wires at ceiling penetrations such as lights and diffusers. Provide additional framing around ceiling access panels.

D. Gypsum Board/Tile Backer Board Installation

1. Manufacturer's Instructions: Unless shown or specified, install gypsum board, including accessories, in accordance with manufacturer's printed instructions.

2. Provide perimeter relief where non-load bearing drywall partitions abut ceilings, vertical elements, or dissimilar materials.

3. Where drywall partitions intersect concrete or masonry, provide control joints not less than 1/4" nor more than 3/8".

4. Gypsum board end joints made between framing members shall be backblocked. Do not back block Tile Backer Board, all joints shall be made over furring.

5. Begin fastening from center portion of sheet and work toward edges and ends. Space fasteners as recommended by manufacturer. Drive screws with power screwdriver.
6. Where partition types change and/or at partition intersections and at inside corners stagger each gypsum board layer and seal layers to each other.
7. Adhesive Application: Apply adhesive to back of drywall after cutting and fitting. Apply with notched trowel or spot per manufacturer's printed instructions. Laminate second layer over first if called for on drawings or required by job conditions.

E. Trim Accessories

1. Finish exposed drywall surfaces with joints, corners and exposed edges reinforced or trimmed as specified, and with all joints, fastener heads, trim accessories, flanges, and surfaces defects filled with joint compound in accordance with drywall manufacturer's recommendations for a smooth, flush surface.
 - a. Place drywall control joints as recommended by USG and directly opposite building control joints.
2. For protection of exposed wallboard edges around openings, provide metal casing bead "J" trim. Provide corner bead at all outside corners.
3. Where drywall abuts or intersects dissimilar construction, provide square edge semi-finishing casing bead, 1/4" joint and caulking in joint.

F. Shaft Wall Installation

1. Position steel runners at floor and ceiling with the short leg toward finish side of wall. Securely attach runners to structural supports with power driven fasteners at both ends and max. 24" o.c. With steel frame construction, install floor and ceiling runners and J-Runners or E-Studs on columns and beams before steel is fireproofed. Remove spray-fireproofing from runners and E-Studs before installing gypsum liner panels. If fireproofing is removed replace with Thermafiber Insulation packed in place.
2. Cut liner panels 1" less than floor-to-ceiling height and erect vertically between J-Runners. Where shaft walls exceed max. available panel height, position liner, panel and joints within upper and lower third points of wall. Stagger joints top and bottom in adjacent panels and reinforce end joints with horizontal C-H stud or 1" H-Spline. Screw attach studs to runners on walls over 16' high.
3. Use steel C-H studs 3/8" to not more than 1/2" less than floor-to-ceiling height, and install between liner panels with liner inserted in the groove. Install full-length steel E-Studs or J-Runners vertically at T-intersections, corners, door jambs, and columns. Install full-length E-Studs over gypsum liner panels both sides of closure

panels. Frame openings cut within a liner panel with J-Runner around perimeter. For openings, frame with vertical E-Stud or J-Runner at edges, horizontal J-Runners at head and sill and reinforcing as shown on the drawings. Suitably frame all openings to maintain structural support for wall.

4. Install floor-to-ceiling steel J-Runners or E-Studs each side of steel hinged door frames and ceiling runners with two (2) 3/8" Type S-12 Pan Head Screws. Attach strut-studs to jamb anchors with 1/2" Type S-12 screws. Over steel doors, install a cut-to-length section of J-Runner and attach to strut-studs with 3/8" Type S-12 Screws.

G. Finishing Gypsum Board: Tape and sand to feather all joints for smooth uniform surface. Final finish wipe joints with moist sponge.

H. Acoustic and Firesafing Insulation

1. Install between metal wall framing studs, soffits, etc. where shown on drawings, with friction fit. Stuff into all gaps. Tightly butt all end joints.

2. At fire rated walls install firesafing between top runner track and metal deck. Stuff firesafing into deck flutes full width of wall.

3. Lay on top of suspended acoustic ceiling. Do not hold tight to recessed light fixtures unless fixtures are rated to accept insulation covering. Do not cover fixtures unless approved by Contracting Officer.

I. Miscellaneous

1. Sealant: Install acoustic sealant at all acoustic rated partitions between tracks and structure at floor and deck. Seal around all penetrations through the wall including electrical outlets.

J. Make provisions to minimize spattering of compound on other work. Promptly remove compound from doors, frames, floors, and other surfaces.

3.2 ADJUST AND CLEAN

A. Clean premises of all litter, dirt and debris is created by work of this Section. Leave premises broom clean.

END OF SECTION

SECTION 09300 - TILE

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

Types of tile work in this section include the following:

Unglazed ceramic mosaic tile.

Glazed wall tile.

Shower pans.

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

Division 3 Section "Concrete Work" for monolithic slab finishes specified for tile substrates.

Division 4 Section "Unit Masonry" for concrete unit masonry substrate.

SUBMITTALS

Product data for each type of product specified.

Samples for initial selection purposes in form of manufacturer's actual tiles or sections of tile showing full range of colors, textures, and patterns available for each type and composition of tile indicated. Included samples of grout and accessories involving color selection.

Samples for verification purposes of each item listed below, prepared on samples of size and construction indicated, products involving color and texture variations, in sets showing full range of variations expected.

Each type and composition of tile and for each color and texture required, at least 12 inches square, mounted on plywood or hardboard backing and grouted.

Full-size units of each type of trim and accessory for each color required.

Metal edge strips in 6-inch lengths.

QUALITY ASSURANCE

Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

Single-Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.

Installer Qualifications: Engage an experienced Installer who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.

PRODUCT HANDLING

Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.

PROJECT CONDITIONS

Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup. Maintain temperatures at not less than 50°F (10°C) in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide products by one of the following:

Unglazed Ceramic Mosaic Tile:

American Olean Tile Co., Div., National Gypsum Co.
Summitville Tiles, Inc.
United States Ceramic Tile Co.
Winburn Tile Manufacturing Co.

Glazed Wall Tile:

American Olean Tile Co., Div., National Gypsum Co.

Summitville Tiles, Inc.
United States Ceramic Tile Co.

Latex-Emulsion-Based Latex-Portland Cement Mortars and Grouts:

American Olean Tile Co., Inc.
Bostik Construction Products Div.
C-Cure Chemical Co.
DAP Inc. Div.; USG Corp.
L & M Mfg. Inc.
Laticrete International Inc.
Summitville Tiles, Inc.

PRODUCTS, GENERAL

ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types and grades of tile indicated.

Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.

ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.

Colors, Textures and Patterns: For tile and other products requiring selection of colors, surface textures or other appearance characteristics, provide products, including accent tile colors, as selected by Contracting Officer from manufacturer's standards.

Provide tile trim and accessories which match color and finish of adjoining flat tile.

TILE PRODUCTS

Unglazed Ceramic Mosaic Tile: Provide flat tile complying with the following requirements:

Type: Natural clay.
Wearing Surface: Without abrasive content.
Nominal Facial Dimensions: 2" x 2".
Nominal Thickness: 1/4".
Face: Plain with square edges.

Glazed Wall Tile: Provide flat tile complying with the following requirements:

Nominal Facial Dimension: 2" x 2".
Nominal Thickness: 5/16".
Face: Plain with cushion edges.

Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with following requirements:

Size: As indicated, coordinated with sizes and coursing of adjoining flat tile, where applicable.

Shapes: As follows, selected from manufacturer's standard shapes:

Base for Thinset Mortar Installations: Straight.

Wainscot Cap for Thinset Mortar Installations: Surface bullnose.

External Corners for Thinset Installations: Surface bullnose.

Internal Corners: Field-buttet square corners, except use internal coved and cap angle pieces designed to member with stretcher shapes.

Special Shapes: Provide stop shapes and returns as required at door jambs where frames do not provide sufficient stop for the work.

Accessories for Glazed Wall Tile: Provide vitreous china accessories of type and size indicated and in color and finish to match adjoining glazed wall tile.

One soap holder for each shower equal to Willette Corp., No. 276 shower and tub soap dish, 8-1/2" w x 4-1/4" h x 3" d. Soap dish shall be fully recessed. Color as selected by Contracting Officer.

SETTING MATERIALS

Portland Cement Mortar Bed: Comply with ANSI A108.1. Provide mortar setting bed in shower areas as shown on drawings.

Thin-Set Portland Cement Mortar: Where thin-set portland cement mortar applications are indicated, use the following unless otherwise required.

Dry-set portland cement mortar, ANSI A118.1, factory sanded; or latex portland cement mortar, ANSI A 118.4.

Chemical-Resistant Epoxy Mortar: ANSI A118.3.

Provide product capable of resisting continuous and intermittent exposure to temperatures of up to 140 deg F (60 deg C) and 212 deg F (100 deg C), respectively, as certified by mortar manufacturer for intended use.

Use chemical-resistant epoxy mortar at ceramic tile floors.

SHOWER PAN

PVC Shower Pan Membranes: Provide 40 mil thick flexible PVC sheet shower pan membrane at shower area equal to COMPOSEAL shower pan as manufactured by Compotite Corp. All seams shall be lapped and sealed per manufacturer's recommendations. Provide complete with all components including preformed corner/curb protectors.

GROUTING MATERIALS

Latex-Portland Cement Grout: Proprietary preblended compound of portland cement, selected and graded aggregates, color pigments and chemical additives gaged with latex additive to comply with manufacturer's directions. Comply with ANSI A118.6.

Use latex additive in grout which is compatible with latex additive in latex-portland cement mortar.

Use latex-portland cement grout in wall joints.

Chemical-Resistant Epoxy Grout: ANSI A118.3.

Provide product compatible with epoxy mortar. Use at ceramic tile floor.

Grout Colors: Grout colors shall be as selected by Contracting Officer.

ELASTOMERIC SEALANTS

General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with requirements of Division 7 Section "Joint Sealers," including ASTM C 920 as referenced by Type, Grade, Class, and Uses.

Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

One-Part Mildew-Resistant Silicone Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and as applicable to nonporous joint substrate indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes.

Products: Subject to compliance with requirements, provide one of the following:

One-Part Mildew-Resistant Silicone Sealant:

"Dow Corning 786"; Dow Corning Corp.

"SCS 1702"; General Electric Co.

"863 #345 White"; Pecora Corp.

"Proglaze White"; Tremco Corp.

Chemical-Resistant Sealants: For chemical-resistant floors, provide sealants compatible with chemical-resistant mortars and grouts, approved for use indicated by manufacturers of both mortar/grout and sealant and with chemical-resistant properties equivalent to mortar/grout.

MISCELLANEOUS MATERIALS

Metal Edge Strips: Zinc alloy or stainless steel strips, 1/8" wide at top edge with integral provision for anchorage to substrate, unless otherwise indicated.

Tile Cleaner: Product specifically acceptable to manufacturer of tile and grout manufacturer for application indicated and as recommended by National Tile Promotion Federation or Ceramic Tile Institute.

MIXING MORTARS AND GROUT

Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

EXAMINATION

Examine substrates and areas where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

Concrete floor shall be smooth and flat. Refer to Section 03310 for required tolerances and other specified self-leveling compounds. Verify acceptability of all self-leveling compounds with ceramic tile manufacturer.

Grind down all ridges and other irregularities.

Fill all cracks, holes, and depressions with leveling and patching compounds as recommended by ceramic tile manufacturer.

Check with the Contractor to insure that the effects of the concrete curing agent have been removed and that the proper finish to receive the tile work is on the floor.

Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing

compounds.

Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.

Do not proceed with installation until unsatisfactory conditions have been corrected.

PREPARATION

Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

INSTALLATION, GENERAL

ANSI Tile Installation Standard: Comply with applicable parts of ANSI 108 series of tile installation standard included under "American National Standard Specifications for the Installation of Ceramic Tile."

TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated and as applicable to installation conditions shown.

Extend tile work into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.

Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures and other penetrations so that plates, collars, or covers overlap tile.

Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on base, walls, and trim are same size. Layout tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths.

Grout tile to comply with referenced installation standards, using grout materials indicated.

Mix and install proprietary components to comply with grout manufacturer's directions.

FLOOR INSTALLATION METHODS

Ceramic Mosaic Tile: Install tile to comply with requirements indicated below for setting bed methods, TCA installation methods related to types of subfloor construction, and grout types:

Portland Cement Mortar Bed: ANSI A108.1

Concrete Subfloors in Showers: TCA F112.

Grout: Chemical-resistant epoxy.

Chemical-Resistant Epoxy Mortar and Grout: ANSI A108.9.

Concrete Subfloors, Interior: TCA F131.

Grout: Chemical-resistant epoxy.

Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet or other flooring which finishes flush with top of tile.

WALL TILE INSTALLATION METHODS

Install types of tile designated for wall application to comply with requirements indicated below for setting bed methods, TCA installation methods related to subsurface wall conditions, and grout types:

Thin-Set Latex-Portland Cement Mortar (Interior): ANSI A108.5.

Masonry, Interior: TCA W202.

Grout: Latex-portland cement.

Install sealant at all joints at interior corners and door jambs.

CLEANING AND PROTECTION

Cleaning: Upon completion of placement and grouting, clean all tile surfaces so they are free of foreign matter.

Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but not sooner than 14 days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.

Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with Kraft paper or other heavy covering during construction period to prevent staining, damage and wear.

Prohibit foot and wheel traffic from using tiled floors for at least 7 days after grouting is completed.

Before final inspections, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09300

09500- ACOUSTICAL TREATMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Conditions of the Contract and Division 1 apply to this Section.
- B. Supply and install, complete in place; all acoustical treatment work as indicated on the drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 09260 - Metal Stud and Gypsum Board Systems
- B. Section 09900 - Painting
- C. Division 15 - Mechanical
- D. Division 16 - Electrical

1.3 QUALITY ASSURANCE

- A. Acoustical treatment installer shall have a minimum of two (2) years experience on similar scope projects. Installer shall be approved by manufacturer.
- B. Comply with all applicable requirements of the Acoustical Materials Association Bulletin AArchitectural Acoustical Materials@, and with all referenced ASTM standards.
- C. Allowable Deflection: ASTM C-636, Mounting Type E-400, L/360 Maximum.
- D. Out-of-Level Tolerance: Level within 1/8 inch in 12 feet.
- E. Reference Standards
 - 1. ASTM C 635, Spec. For Metal Suspension System for Acoustical Tile and Lay-In Panel Ceilings.
 - 2. ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.
 - 3. ASTM E 1264, Classification for Acoustical Ceiling Products.

1.4 PERFORMANCE REQUIREMENTS

- A. Flame Spread: ASTM E 84; 25 or less
- B. Smoke Development: 50 or less

1.5 SUBMITTALS

- A. Refer to Section 01300 for Submittal Requirements.

- B. Product Data: Manufacturers descriptive literature with technical data indicating materials, tests and installation and storage instructions.
- C. Shop Drawings: Submit showing complete layout of all systems including attachments, intersections of members, and edge conditions.
- D. Calculations: Submit calculations as evidence that main runners can support weight of ceiling, lighting fixtures, and air distribution units within allowable deflection.
- E. Maintenance Data: Submit two (2) copies of the manufacturers recommendations regarding maintenance, care and cleaning of acoustical treatments.
- F. Samples: Two (2) full size units of each acoustical treatment and three (3) 6" lengths of each suspension member.
- G. Qualifications: Installer
- H. Seismic Data

1.6 EXTRA MATERIALS

- A. Leave with owner 2% of each type of acoustical treatment used.
- B. Store in carton in area directed by Contracting Officer.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to jobsite in manufacturer=s original, unopened packaging and adequately protect against damage while stored in dry and heated location at the site.
- B. Deliver materials to jobsite after all glazing has been completed and all exterior openings enclosed. All wet work, including concrete, drywall, plastering, etc. shall be completed and dried out.
- C. Material shall be stored at jobsite a minimum of 24 hours prior to their installation.
- D. Remove all damaged and unsuitable material from the jobsite immediately.

1.8 ENVIRONMENTAL CONDITIONS

- A. Protect adjoining work surfaces before the work begins.
- B. Do not install acoustical materials until permanent heating and cooling systems are operating and allowable temperature and humidity can be maintained.
- C. Maintain 65EF and 50% maximum relative humidity 48 hours prior, during and after installation of materials.
- D. Maintain minimum temperature of 55EF thereafter.

PART 2 - PRODUCTS

- A. See the Architectural Finishes List bound into this specification for manufacturer, type, size, color and pattern of acoustical ceilings.
- B. Suspension System
 - 1. Type 1 Exposed Grid: Chicago Metallic Corporation, Intermediate Duty, Tempra 4000 Series, snap lock, double web steel with face cap.
 - a. Color: Standard White
 - b. 1" deep x nom. 1/2" face main tees
 - c. 1" deep x nom. 1/2" face cross tees
 - d. 3/4" x 3/4" perimeter angles
 - 2. Type 2 Exposed Grid: Chicago Metallic Corporation Heavy Duty, 200 Series, snap lock, double web steel with face cap.
 - a. Color: Standard White
 - b. 1" deep x nom. 1" wide face main and cross tees.
 - c. 3/4" x 3/4" perimeter angles.
 - 3. Type 3 Concealed Grid: Chicago Metallic Corporation, 221 System
 - a. Color: Standard White
 - b. 1" deep x nom. 1" wide face main and cross tees.
 - c. 3/4" x 3/4" perimeter angles
- C. Suspension Wire: Soft annealed galvanized mild steel wire - 12 gauge.
- D. Suspension Channels: 1-1/2" cold or hot rolled steel channels/galvanized. Minimum .475 lbs per L. F.
- E. Edge Moldings: metal wall angle with single flange exposed, pre-punched for wall attachments.
- F. Screws: Type and size as required by conditions
- G. Anchors: Provide drill-in anchors with eyelet to accept suspension wire. Builder, Hilti, Rawl Tec, or equal. Power driven fasteners not allowed.
- H. Hold-Down Clips:
 - 1. Vestibules

- I. Tile Adhesive: ASTM D 1779, UL labeled with Class 0-25 flame spread rating.
- J. Ceiling Light Baffles
 - 1. CA Supply Co. Straight blade Aluminum Cross baffle, 1" deep blades on 1" enters. Butt ends of panels to have partial spacing to form full cells.
 - a. Length: 4' - 0"
 - b. Width: 11 3/4"
 - c. Finish: Clear Anodized Aluminum
- K. AWP - 1: Acoustical Wall Panels
 - 1. Conwed ARespond@ ACT 050, 1/2" thick, square edge, with fabric covering. Fabric covering shall be provided by panel manufacturer. Fabric will have two (2) coats of acrylic backing. Resin harden areas at fasteners. See Architectural Finishes List for fabric manufacturer and type.
 - 2. Fasteners: Black phosphate coated coarse thread Adrywall@ screws 1 1/4" long and black finished shoulder Afinishing@ washers, diameter to be approved by Contracting Officer.
- L. ATP - 1: Track Panels:
 - 1. Conwed ARespond@ track panels, 1/2" thick, square edge, with fabric covering provided by the panel manufacturer. See Architectural Finishes List for fabric manufacturer and type.
 - a. Return fabric minimum 1 - 1/2".
 - b. Surface Burning - ASTM E - 84, Class A.
 - c. High density mineral fiberboard.
- M. Eggerate Grilles: 1/2" cube injection molded, one piece translucent white acrylic.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine all subsurfaces to receive the work and report in writing to General Contractor, with copy to Contracting Officer, any detrimental conditions to the work. Failure to observe this injunction constitutes a waiver to any subsequent claims to the contrary and holds acoustical unit Contractor responsible for any corrections the Contracting Officer may require. Commencement of the work will be construed as acceptance of all subsurfaces.
- B. Coordinate required surface corrections with contractor responsible for installation.

3.2 INSTALLATION

A Coordination

1. Prior to the beginning of ceiling work, the ceiling Contractor and other Contractors whose work is related to the ceiling installation shall identify all areas of potential interference between ceiling components and components from other trades. Ceiling Contractor shall coordinate layout requirements with Plumbing, Heating & Ventilation and Electrical Contractors.
2. All areas of the interference which arise following the beginning of ceiling construction shall be reported by the Contractor involved to the General Contractor as soon as the interference is observed. Such interference shall be resolved by the General Contractor with the assistance of the Contractors involved.

B. General

1. Install acoustical ceiling panels and suspension systems, including necessary hangers, grillage, spines, and other hardware supporting the acoustical materials in accordance with ASTM C - 635 and C - 636.
2. Install suspension systems in accordance with Uniform Building Code Standard No. 47 - 18.

C. Layout

1. Install per manufacturers written instruction and recommendations.
2. Follow reflected ceiling plan on drawings.
3. Acoustical materials shall be installed in a true and even plane, in straight line design with courses laid out symmetrically about center lines of room or area with border units of greatest possible size.
4. Border units shown not be less than 1/2 unit in width.
5. Fissures of tile shall run in one direction within each room or area. Coordinate directions with [Architect/Engineer][Contracting Officer] prior to placing tile.
6. Provide additional hanger wires at light fixtures, diffusers, cubicle tracks, and other ceiling penetrations.
7. Neatly scribe and cut panels to fit tightly to all ceiling penetrations. At reveal edge panels, field or shop trim to conform to factory edge detail at all adjoining surfaces. Finish field cut reveal edges to match panel face surfaces.
8. Provide metal closure moulding at all vertical surfaces and junctures with other materials. Closures shall be neatly formed to provide neat tight closures against all surfaces, including bullnose masonry, and other similar curved or irregular surfaces.

D. Suspension System: Exposed Grid

1. Suspension system shall consist of main tees at 48 inch centers, supported by not less than

12 gauge wires at 48 inch centers maximum. Cross tees at 24 inch centers creating a 24 inch x 24 inch module.

E. Suspension System: Concealed Grid

1. Suspension system shall consist of main tees at 48 inch centers, supported by not less than 12 gauge wires at 48 inch centers maximum. Cross tees and /or access angles shall be spaced at 12 inch centers.
 - a. System shall be complete with perimeter moulding, spring clips at perimeter edges, splines, spacer bars to stabilize system, and white vinyl slip-on trim mouldings at recessed light fixtures.
 - b. Provide a minimum of 10% accessibility with upward access at locations to be determined in field. Each access panel shall be identified by use of pins with color coated heads. Minimum size of access panels shall be 12 inches x 24 inches.

F. Attachment

1. Hanger connection to structure shall develop the full strength of the hanger.
2. Fastening of hangers to existing ceilings will not be permitted. Hangers shall be secured to the structural slab above the existing ceilings using drilled anchors of mechanically expanding design.
3. Method of hanger anchorage to concrete shall be drilled anchors, of a permanent, mechanically expanded type.
4. Hangers shall be attached to steel structure by attachment to steel beams, joists and/or metal deck. Attachment to metal deck shall be by dropping pigtail hangers through holes drilled in the deck or by running hanger through holes drilled in both vertical webs of a flute and tying properly.
5. Where duct work occurs, making it impossible to maintain spacing of hangers, provide additional hangers as required to support larger runners necessary for longer spans. Punching of ducts and extending hangers through ducts will not be permitted.
6. All wire hangers at suspended systems shall be hung vertically. Provide supplemental framing as required.
7. Mail runner shall be installed so that they are all level within 1/8 inch in 12 feet. Leveling shall be performed with the supporting hangers taut to prevent any subsequent downward movement when the ceiling loads are imposed. Local kinks or bends shall not be made in hanger wires as a means of leveling. Hanger wires shall be positively connected to prevent slippage.
8. Cross runners supported by either main runners or by other cross runners shall be installed as the required center distance with 1/32 inch. This tolerance shall be noncumulative beyond 12 feet. Intersecting runners shall form a right angle. Abutting sections of main

runner shall be jointed by means of a suitable connection such as splices, interlocking ends, tab locks, or pin locks.

G. Acoustical Wall and Tack Panels

1. Install on wall surface with specified mechanical fasteners at each corner formed by the wood strips; see drawings.
2. Stretch fabric over core and fully adhere to face with recommended adhesive. Wrap edged and return on back to hold fabric in place.
3. Install additional latex spray layer to back of fabric.

H. Ceiling Light Baffles:

1. Install light baffles in specified ceiling grid and edge moulding. Install in light cove. Ends of panels shall be connected without deviation or offset entire length.

3.3 ADJUST AND CLEAN

- A. Clean soiled acoustical treatment after installation. Remove and replace damaged units.
- B. Touch up paint may be used to repair minor surface and edge damage with Contracting Officer's approval.
- C. Clean premises of all litter, dirt and debris created by work of this Section. Leave premises broom clean.

END OF SECTION

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes acoustical panel ceilings installed with exposed suspension systems.

Provide acoustical panel ceilings as scheduled and specified.

Related Sections: The following sections contain requirements that relate to this section:

Division 15 Section for grilles, registers, diffusers, sprinkler heads, etc. in acoustical ceilings.

Division 16 Section for lighting fixtures, detectors, and speakers, etc., in acoustical ceilings.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product Data for each type of product specified including installation instructions for each acoustical ceiling material required, and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications.

Include manufacturer's recommendations for cleaning and refinishing acoustical units, including precautions against materials and methods which may be detrimental to finishes and acoustical performances.

Samples for verification purposes of each type of exposed finish required, prepared on samples of size indicated below and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

Full-size samples of each panel pattern and color required.

Set of 12-inch-long samples of exposed suspension system members, including moldings, for each color and system type required.

Product test reports from qualified independent testing laboratory that are based on its testing of current products for compliance of acoustical ceiling systems and components with requirements.

QUALITY ASSURANCE

Installer Qualifications: Engage an experienced Installer who has successfully completed acoustical ceilings similar in material, design, and extent to those indicated for Project.

Fire-Performance Characteristics: Provide acoustical ceilings that are identical to those tested for the following fire-performance characteristics, per ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.

Flame Spread: 25 or less.

Smoke Developed: 50 or less.

Single-Source Responsibility for Ceiling Units: Obtain each type of acoustical ceiling unit from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, and partition system.

DELIVERY, STORAGE, AND HANDLING

Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

PROJECT CONDITIONS

Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

PART 2 - PRODUCTS

MANUFACTURERS

Products: Subject to compliance with requirements, provide one of the following:

CEILING TYPE A: Mineral Base Panels - Water Felted, with Painted Finish and Perforated and Fissured Pattern, Non-Fire-Resistance Rated:

"Designer Minatone", Armstrong World Industries, Inc.
"Hytone Textured Baroque", Celotex.
"Auratone Natural Textured Aspen", USG Interiors.

CEILING TYPE B: Mineral Base Panels - Wet Formed, with Plastic Membrane-Faced Overlay, Non-Fire-Resistance Rated:

"Armashield RH90", Armstrong World Industries, Inc.
"Vantage 10", Celotex.
"Auratone Metal Face (Perforated)", USG Interiors.

Non-Fire-Resistance-Rated Wide-Face Double-Web Steel Suspension Systems:

Armstrong World Industries, Inc.
Chicago Metallic Corporation.
National Rolling Mills, Inc.
USG Interiors, Inc.

ACOUSTICAL CEILING UNITS, GENERAL

Standard for Acoustical Ceiling Units: Provide manufacturers' standard units of configuration indicated that comply with ASTM E 1264 classifications as designated by reference to types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

Colors and Patterns: Provide products to match appearance characteristics indicated under each product type.

MINERAL BASE PANELS - WATER FELTED, NON-FIRE-RESISTANCE RATED (TYPE A)

Type, Form, and Finish: Provide type III, Form 2 units per ASTM E 1264 with painted finish that comply with pattern and other requirements indicated.

Perforated Pattern: Units matching pattern indicated by reference to manufacturers' standard pattern designations, with other characteristics as follows:

Color/Light Reflectance Coefficient: White/LR 0.75 - 0.80.

Noise Reduction Coefficient: NRC 0.55.

Ceiling Sound Transmission Class: Minimum 40.

Edge Detail: Tegular lay-in.

Size: 24 inches by 24 inches by 5/8 inch and as indicated and required.

MINERAL BASE PANELS, WET-FORMED, WITH PLASTIC MEMBRANE FACED OVERLAY (TYPE B)

Type, Form, and Finish: Provide type X, Form 2 units per ASTM E 1264 with white polymeric membrane, complying with pattern and other requirements indicated.

Perforated Pattern: Designation CG (perforated with small holes and smooth), with other characteristics as follows:

Color/Light Reflectance Coefficient: White/LR 0.80.

Noise Reduction Coefficient: NRC 0.65.

Ceiling Sound Transmission Class: Minimum 40.

Edge Detail: Square cut lay-in.

Size: 24 inches by 24 inches by 3/4 inch and as indicated and required.

Surface Burning Characteristics: Class A.

Environmental Characteristics: Impact-resistant, stain-resistant, and no visible sag under conditions not to exceed 90° F and 90 % humidity.

METAL SUSPENSION SYSTEMS, GENERAL

Standard for Metal Suspension Systems: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

Finishes and Colors: Provide manufacturer's standard factory-applied finish for type of system indicated.

Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

Gage: Provide wire sized so that stress at 3 times hanger design load (ASTM C 635, Table 1,

Direct-Hung), will be less than yield stress of wire, but provide not less than 0.106-inch diameter (12 gage).

Hanger Rods: Mild steel, zinc coated, or protected with rust- inhibitive paint.

Flat Hangers: Mild steel, zinc coated, or protected with rust inhibitive paint.

Angle Hangers: Angles with legs not less than 7/8 inch wide, formed with 0.0365-inch-thick galvanized steel sheet complying with ASTM A 446, Coating Designation G90, with bolted connections and 5/16-inch-diameter bolts.

Edge Moldings and Trim: Metal of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit type of edge detail and suspension system indicated in matching color.

For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

Hold-Down Clips: Provide hold-down clips for ceilings in vestibules. Clips shall be spaced 2'-0" o.c. on all crossties.

NON-FIRE-RESISTANCE-RATED DIRECT-HUNG SUSPENSION SYSTEMS

Wide-Face Capped Double-Web Steel Suspension System: Main and cross-runners roll-formed from pre-painted or electrolytic zinc-coated cold-rolled steel sheet, with pre-finished 15/16-inch-wide metal caps on flanges; other characteristics as follows:

Structural Classification: Intermediate-Duty System.

End Condition of Cross-Runners: Override (stepped) or butt-edge type, as standard with manufacturer.

Cap Material and Finish: Steel sheet painted white.

MISCELLANEOUS MATERIALS

Concealed Acoustical Sealant: Nondrying, non-hardening, non-skinning, non-staining, non-bleeding, gunnable sealant complying with requirement specified in Division 7 Section "Joint Sealers."

PART 3 - EXECUTION

EXAMINATION

Examine substrates and structural framing to which ceiling system attaches or abuts, with Installer present,

for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with installation until unsatisfactory conditions have been corrected.

PREPARATION

Coordination: Furnish layouts for inserts, clips, and other ceiling anchors.

Furnish inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half-width units at borders, and comply with reflected ceiling plans.

INSTALLATION

General: Install acoustical ceiling systems to comply with installation standard referenced below, per manufacturer's instructions and CISCA "Ceiling Systems Handbook."

Standard for Installation of Ceiling Suspension Systems: Comply with ASTM C 636.

Arrange acoustical units and orient directionally patterned units as directed.

Install tile with pattern running in one direction.

Suspend ceiling hangers from building structural members and as follows:

Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

Hanger wires shall not penetrate ductwork.

Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices that are secure and appropriate for structure to

which hangers are attached as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

Do not attach hangers to metal roof deck. Attach hangers to structural members.

Space hangers not more than 4'-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.

Install edge moldings of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical units.

Screw-attach moldings to substrate at intervals not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.

Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.

Install hold-down clips as specified.

CLEANING

Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09511

SECTION 09650 - RESILIENT FLOORING

PART 1 - GENERAL

RELATED DOCUMENTS

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

DESCRIPTION OF WORK

Extent of resilient flooring and accessories are shown on drawings and in schedules.

SUBMITTALS

Product Data: Submit manufacturer's technical data for each type of resilient flooring and accessory, including leveling compounds.

Samples for Initial Selection Purposes: Submit manufacturer's standard color charts in form of actual sections of resilient flooring, including accessories, showing full range of colors and patterns available, for each type of resilient flooring required.

Samples for Verification Purposes: Submit the following samples of each type, color and pattern of resilient flooring required, showing full-range of color and pattern variations.

Full size tile samples.

2 1/2" long samples of resilient flooring accessories.

Other materials as requested.

Maintenance data for resilient floor tile, to include in Operating and Maintenance Manual specified in Division 1.

QUALITY ASSURANCE

Single-Source Responsibility for Floor Tile: Obtain each type, color, and pattern of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

Provide each type of resilient flooring and related accessories as produced by a single manufacturer, including recommended primers, adhesives and sealants.

Leveling compounds used over existing concrete floors shall be acceptable to and approved by resilient flooring manufacturer.

Fire Performance Characteristics: Provide resilient floor tile with the following fire performance

characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

Critical Radiant Flux: 0.45 watts per sq. em or more per ASTM E 648.

Smoke Density: Less than 450 per ASTM E 662.

DELIVERY, STORAGE, AND HANDLING

Deliver tiles and installation accessories to Project site in original manufacturer's unopened cartons and containers each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

Store flooring materials in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).

Store tiles on flat surfaces. Move tiles and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.

PROJECT CONDITIONS

Maintain minimum temperature of 70°F (21°C) in spaces to receive resilient flooring for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Subsequently, maintain minimum temperature of 55°F (13°C) in areas where work is completed.

Do not install tiles until they are at the same temperature as the space where they are to be installed. Close spaces to traffic during tile installation.

SEQUENCING AND SCHEDULING

Install tiles and accessories after other finishing operations, including painting, have been completed.

Do not install tiles over leveling compound or concrete slabs until leveling compound and slabs have cured and are sufficiently dry to bond with adhesive as determined by tile manufacturer's recommendations and recommended bond and moisture tests.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide products of one of the following:

Manufacturers of Vinyl Composition Tile:

Armstrong World Industries, Inc., Standard Excelon, Imperial Texture.

Azrock Industries Inc., 800 Series.
Kentile Floors, Inc., Standard Architectural Series.
Tarkett Inc., Basic Expressions.

Manufacturers of Rubber Wall Base:

Burke Flooring Products.
Musson Rubber Co.
Roppe Corp.

RESILIENT FLOORING COLORS AND PATTERNS

Provide color and patterns as selected by Contracting Officer from manufacturer's full range of colors.

TILE FLOORING

Vinyl Composition Tile: FS SS-T-312B, Type IV; 12" x 12" unless otherwise indicated, and as follows:
Composition 1 - Asbestos-free.

Gage: 1/8".

RESILIENT WALL BASE

Rubber Wall Base: Provide rubber base complying with FS SS-W-40; Type I with matching end stops and preformed or molded corner units, and as follows:

Height: 4"

Thickness: 1/8" gage.

Style: Standard top-set cove, except straight base without cove at carpet locations.

Finish: Matte.

RESILIENT ACCESSORIES

Resilient Edge Strips: 1/8" thick, homogeneous vinyl or rubber composition, tapered or bullnose edge, color to match flooring, or as selected from manufacturer's full range of profiles and colors.

INSTALLATION ACCESSORIES

Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.

Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

Adhesives: Water-resistant type recommended by manufacturer to suit resilient flooring product and substrate conditions indicated.

PART 3 - EXECUTION

EXAMINATION

General: Examine areas where installation of tiles will occur, with Installer present, to verify that substrates and conditions are satisfactory for tile installation and comply with tile manufacturer's requirements and those specified in this Section.

Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by tile manufacturer.

Finishes of subfloors comply with tolerances and other requirements specified in Division 3 Section "Cast-In-Place Concrete" for slabs receiving resilient flooring.

Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits of any kind.

Do not proceed with installation until unsatisfactory conditions have been corrected. Correction of unsatisfactory conditions is the sole responsibility of the General Contractor.

PREPARATION

General: Comply with manufacturer's installation specifications for preparing substrates indicated to receive products indicated.

Use trowelable leveling and patching compounds per manufacturers directions to fill cracks, holes, and depressions in substrates.

Concrete floor shall be smooth and flat. Refer to Section 03300 for required tolerances and other specified self-leveling compounds. Verify acceptability of self-leveling compounds with resilient flooring manufacturer.

Grind down all ridges and other irregularities.

Fill all cracks, holes and depressions with trowelable leveling and patching compounds as recommended by manufacturer.

Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum

sander, or a polishing machine equipped with a heavy-duty wire brush.

Broom or vacuum clean substrates to be covered immediately before installing products specified in this Section. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

INSTALLATION

General: Comply with manufacturer's installation directions and other requirements indicated that are applicable to each type of installation included in Project.

Extend resilient flooring into toe spaces, door reveals, and into closets and similar openings.

Scribe, cut, and fit resilient flooring to butt tightly to vertical surfaces, permanent fixtures, built-in furniture and cabinets, pipes, outlets and permanent columns, walls, partitions edgings, thresholds, frames and nosings.

Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device.

Install resilient flooring on covers for telephone and electrical ducts, and similar items occurring within finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly adhere edges to perimeter of floor around covers and to covers.

Tightly adhere resilient flooring to flooring substrates without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections. Hand roll resilient flooring at perimeter of each covered area to assure adhesion.

INSTALLATION OF TILE FLOORS

Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of room are of equal width. Adjust as necessary to avoid use of cut widths less than ½ tile at room perimeters. Lay tile square to room axis, unless otherwise shown.

Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Cut tile neatly around all fixtures. Broken, cracked, chipped, or deformed tiles are not acceptable.

Lay tile with grain running in one direction.

Adhere tile flooring to substrates using full spread of adhesive applied in compliance with flooring manufacturer's directions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

INSTALLATION OF ACCESSORIES

Apply resilient wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms and areas where base is required. Install base in lengths as long as practicable, with preformed corner units, or fabricated from base materials with mitered or coped inside corners. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact at horizontal and vertical surfaces.

On masonry surfaces, or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

Install preformed or molded inside and exterior corners before installing straight pieces.

Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which would otherwise be exposed.

CLEANING AND PROTECTION

Perform the following operations immediately upon completion of resilient flooring:

Sweep or vacuum floor thoroughly.

Do not wash floor until time period recommended by resilient flooring manufacturer has elapsed to allow resilient flooring to become well-sealed in adhesive.

Damp-mop floor being careful to remove black marks and excessive soil.

Remove any excess adhesive or other surface blemishes, using appropriate cleaner recommended by resilient flooring manufacturers.

Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by tile manufacturer.

Apply protective floor polish to tile surfaces that are free from soil, visible adhesive, and surface blemishes.

Use commercially available, metal, cross-linked acrylic product acceptable to tile manufacturer.

Coordinate selection of floor polish with Government's maintenance service.

Do not move heavy and sharp objects directly over tiles. Place plywood or hardboard panels over tiles and under objects while they are being moved.

Use dollies to move stationary equipment and furnishings across floors.

Clean resilient flooring not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Clean resilient flooring by method recommended by resilient flooring manufacturer.

Strip protective floor polish, which was applied after completion of installation, prior to cleaning.

Reapply floor polish after cleaning.

END OF SECTION 09650

SECTION 09680 - CARPET

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes carpet, floor preparation, installation, and accessories.

SUBMITTALS

Product data for each type of carpet material and installation accessory required. Submit written data on physical characteristics, durability, resistance to fading, and flame resistance characteristics. Include installation instructions.

Shop drawings showing layout and seaming diagrams. Indicate pile or pattern direction and locations and types of edge strips. Indicate columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet. Show installation details at special conditions.

Samples for Initial Selection Purposes: Submit manufacturer's standard size samples and color yarn showing full range of colors, textures and patterns available for each type of carpet required.

Samples for verification purposes showing full range of color, texture, and pattern variations expected. Prepare samples from same material to be used for the Work. Submit the following:

18-inch-square samples of each type and color of carpet material selected.

12-inch-long samples of each type exposed edge stripping and accessory item.

Maintenance Data: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency; recommended for maintaining optimum condition under anticipated traffic and use conditions. Include precautions against materials and methods which may be detrimental to finishes and performance.

Include maintenance data in Operating and Maintenance Manual specified in Division 1.

QUALITY ASSURANCE

Manufacturer's Qualifications: Firm (material producer) with not less than 5 years of production experience, whose published literature clearly indicates general compliance of products with requirements of this section.

Installer Qualifications: Firm specializing in carpet installation with not less than 5 years of experience in

installation of carpeting similar to that required for this project.

Single Source Responsibility: Provide material produced by a single manufacturer for each carpet type.

Pre-Installation Conference: Prior to floor preparation for installation of carpeting, meet at project site with Installer, carpet manufacturer representative, Architect and other entities concerned with carpeting work and performance. Discuss floor preparation requirements. Record discussions and agreements and furnish copy to each participant.

Leveling compounds used over existing concrete floors shall be acceptable to and approved by carpet manufacturer.

Carpet Surface Burning Characteristics: Provide carpet identical to that tested for the following fire performance characteristics, per test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify carpet with appropriate markings of applicable testing and inspecting organization.

Test Method: DOC FF 1-70.

Rating: Pass.

DELIVERY, STORAGE, AND HANDLING

Deliver materials to project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.

Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat, blocked off ground. Maintain minimum temperature of 68 deg F (20 deg C) at least three days prior to and during installation in area where materials are stored.

PROJECT CONDITIONS

Substrate Conditions: No condensation within 48 hours on underside of 4-foot by 4-foot polyethylene sheet, fully taped at perimeter to substrate.

Substrate Conditions: pH of 9 or less when substrate wetted with potable water and pHydriion paper applied.

SEQUENCING AND SCHEDULING

Sequence carpet installation with other work to minimize possibility of damage and soiling during remainder of construction period.

EXTRA MATERIALS

Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels describing contents.

Carpet: Before installation begins, furnish quantity of full width for each type of material equal to 5 percent of amount installed.

PART 2 - PRODUCTS

MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

Carpet: See Data Sheets at the end of this Section.

ACCESSORIES

Carpet Edge Guard: Extruded or molded heavy-duty vinyl or rubber of size and profile required; minimum 2-inch-wide anchorage flange; manufacturer's standard colors.

Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

Carpet Adhesive: Water-resistant, mildew-resistant and non-staining as recommended by carpet manufacturer, which complies with flammability requirements for installed carpet as recommended by the carpet manufacturer and by installer to meet project circumstances and requirements.

Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement based formulation provided or approved by carpet manufacturer for applications indicated.

PART 3 - EXECUTION

EXAMINATION

General: Examine areas where installation of carpet will occur, with Installer present, to verify that substrates and conditions are satisfactory for carpet installation and comply with carpet manufacturer's requirements and those specified in this Section.

Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet manufacturer.

Finishes of subfloors comply with tolerances and other requirements specified in Division 3 Section "Cast-In-Place Concrete" for slabs receiving carpet.

Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits of any kind.

Do not proceed with installation until unsatisfactory conditions have been corrected. Correction of unsatisfactory conditions is the sole responsibility of the General Contractor.

PREPARATION

General: Comply with manufacturer's installation specifications for preparing substrates to receive products indicated.

Clear away debris and scrape up cementitious deposits from concrete surfaces to receive carpet; apply sealer to prevent dusting.

Patch holes and level to a smooth surface. If previous finish chemically stripped, reseal concrete. Seal powdery or porous surfaces with sealer recommended by carpet manufacturer.

Use trowelable leveling and patching compounds per manufacturer's directions to fill cracks, holes, and depressions in substrates.

Concrete floor shall be smooth and flat. Refer to Section 03300 for required tolerances and other specified self-leveling compounds. Verify acceptability of self-leveling compounds with carpet manufacturer.

Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

Broom or vacuum clean substrates to be covered immediately before installing products specified in this Section. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

INSTALLATION

Install carpet in accordance with manufacturer's recommended procedures.

Comply with manufacturer's recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under door in closed position; do not place seams perpendicular to door frame, in direction of traffic through doorway.

Follow layout and seaming diagrams as submitted and approved.

Extend carpet under removable flanges and furnishings and into alcoves and closets of each space.

Provide cutouts where required, and bind cut edges where not concealed by protective edge guards or overlapping flanges.

Install carpet edge guard where edge of carpet is exposed; anchor guards to substrate.

Glue-Down Installation: Dry lay entire room by overlapping each sheet 3" along its edges. Allow material

to go 3" up the walls. Make sure that all widths are laid in the same pile direction and check for any color variation. Rearrange rolls for best effect if necessary.

Fit sections of carpet prior to application of adhesive. Trim edges and butt cuts with seaming cement.

Apply adhesive uniformly to substrate in accordance with manufacturer's instructions. Butt edges tight to form seams without gaps. Roll entire area lightly to eliminate air pockets and ensure uniform bond.

CLEANING

Remove adhesive from carpet surface with manufacturer's recommended cleaning agent.

Remove and dispose of debris and unusable scraps. Vacuum with commercial machine with face-beater element. Remove soil. Replace carpet where soil cannot be removed. Remove protruding face yarn.

Vacuum carpet.

PROTECTION

Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure carpet is not damaged or deteriorated at time of Substantial Completion.

CARPET SCHEDULE

Provide carpet as scheduled on the following "Data Sheet."

CARPET DATA SHEET

Carpet Manufacturer: Patcraft, "Scholastic 28" or approved equal.

Colors: As selected by Contracting Officer from full range of manufacturer's standard colors.

Face Construction: Textured Loop.

Yarn: SD Nylon.

Tufted Pile Height: 3/16" high, 1/8" long.

Finished Pile Thickness: 0.13 inch minimum.

Gage: 1/10.

Stitches per Inch: 10.3 minimum.

Yarn Weight: 28.0 oz. per sq. yd.

Dye Method: Solution Dyed.

Total Weight: 65.8 oz. per sq. yd. (minimum).

Density: 7,754 oz. per cubic yd. (minimum).

Weight Density: 217,112 (minimum).

Primary Backing: Woven Polypropylene

Secondary Backing: Interlock High Tuft Bind ActionBac

Width: 12 feet.

Wear Warranty: 10 year commercial.

Colorfastness to Light: 10 year warranty.

Colorfastness to Atmospheric Contaminants: 5 year warranty.

Performance Characteristics:

Flammability: Pass methenamine pill test, DOC FF 1-70.

Flame Spread: Critical radiant flux to meet Class 1 as tested by ASTM E 648.

Smoke Density: 450 or less as tested by ASTM E 662.

Static Control: Built-in permanent static control

Soil and Stain Protection: 3M Scotchgard protector.

Traffic Class: Extra Heavy.

END OF SECTION 09680

SECTION 09800 - SPECIAL COATINGS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes applying special coating systems to items and surfaces scheduled, including surface preparation, prime coats, and topcoats.

Types of special coating systems required for the Project include the following:

Special coatings for interior use and metal surfaces at exterior locations as indicated:

Two-Component, high performance, polyamide-epoxy coating on ceilings, walls and striping and letters on floors.

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

General painting is specified in Division 9 Section "Painting."

SUBMITTALS

General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

Product data for each coating system specified, including block fillers and primers.

Provide the manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each material proposed for use.

List each material and cross-reference the specific coating, finish system, and application. Identify each material by the manufacturer's catalog number and general classification.

Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

Samples for initial color selection in the form of manufacturer's color charts.

After color selection, the Contracting Officer will furnish color schedule for surfaces to be coated.

QUALITY ASSURANCE

Applicator Qualifications: Engage an experienced applicator who has successfully completed coating system applications similar in material and extent to those indicated for the Project.

Single-Source Responsibility: Provide primers and undercoat material produced by the same manufacturer as the finish coats for each type of coating. Use only thinners recommended by the manufacturer and only within recommended limits.

Coordination of Work: Review sections in which other coatings are provided to ensure compatibility of the total systems for various substrates. Upon request, furnish information on characteristics of specified finish materials, to ensure that compatible prime coats are used.

Notify the Contracting Officer of problems anticipated using the coatings systems specified.

DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site in the manufacturer's original, new, unopened packages, and containers bearing manufacturer's name and label, and the following information:

Name or title of material.

Product description (generic classification or binder type).

Manufacturer's name, stock number and date of manufacture.

Contents by volume, for major pigment and vehicle constituents.

Thinning instructions.

Application instructions.

Color name and number.

Handling instructions and precautions.

Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue. Protect from freezing.

Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying the coatings.

PROJECT CONDITIONS

SPECIAL COATINGS

Apply coatings only when the temperature of surfaces to be coated and surrounding air temperatures are between 45 deg F (7 deg C) and 95 deg F (35 deg C) unless otherwise permitted by manufacturer's printed instructions.

Do not apply coatings in snow, rain, fog, or mist; when the relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

Allow wet surfaces to dry thoroughly and attain the temperature and conditions specified before proceeding with or continuing the coating operation.

Work may continue during inclement weather only if areas and surfaces to be coated are enclosed and the temperature within the area can be maintained within limits specified by the manufacturer during application and drying periods.

PART 2 - PRODUCTS

SPECIAL COATING MATERIALS, GENERAL

Material Compatibility: Provide block fillers, primers, finish coat material, and related materials that are compatible with one another and the substrates indicated under conditions of service and application as demonstrated by the manufacturer based on testing and field experience.

Material Quality: Provide the highest grade of the various coatings as regularly manufactured by acceptable coating manufacturers. Materials not displaying manufacturer's identification as a best-grade product will not be acceptable.

Colors: Provide color selections made by the Contracting Officer from the manufacturer's full range of colors.

INTERIOR FINISH-COAT MATERIALS

Manufacturers: Subject to compliance with requirements, provide products of one of the following:

PPG Industries, Pittsburgh Paints (PPG).
Sherwin Williams.
Tnemec Company, Inc. (Tnemec).

Masonry Block Fillers: Provide the manufacturer's recommended factory-formulated concrete masonry block fillers that are compatible with the finish materials indicated and suitable to constant wet or exposed to constant moisture and humidity.

Products: Subject to compliance with requirements, provide one of the following:

Block Fillers under Two-Component, High-Performance, Polyamide-Epoxy Coatings:

PPG: 97-685/97-686 Aquapon Polyamide-Epoxy Block Filler.
Sherwin Williams: B42W46 Heavy duty Block Filler.
Tnemec: 54-660 Epoxy-Polyamide Masonry Filler.

Primer/Sealers: Provide the manufacturer's recommended factory-formulated primer/sealers that are compatible with the substrate and finish materials indicated.

Interior Finish-Coat Materials: Provide the manufacturer's recommended factory-formulated, interior, finish-coat materials.

Products: Subject to compliance with requirements, provide one of the following:

High-Performance, Polyamide-Epoxy Coatings: High Gloss.

PPG: Aquapon Polyamide-Epoxy 97 Series Ready-mix Colors or Bases.
Sherwin Williams: Tile-Clad II Epoxy.
Tnemec: Series 66 Hi-Build Epoxoline.

PART 3 - EXECUTION

EXAMINATION

Examine substrates and conditions under which coatings will be applied for compliance with requirements on applying coatings. Surfaces to receive coatings must be thoroughly dry before coatings are applied.

Do not proceed with coating application until unsatisfactory conditions have been corrected. Correction is the sole responsibility of the General Contractor.

Start of application will be construed as the Applicator's acceptance of surfaces within that particular area.

PREPARATION

General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already in place that are not to be coated, or provide surface-applied protection prior to surface preparation and coating. Remove these items, if necessary, to completely coat the items and adjacent surfaces. Following the coating operations in each space or area, have removed items reinstalled by workers skilled in the trades involved.

Cleaning: Before applying coatings or other surface treatments, clean the substrates of substances that could impair bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and coating application so dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.

Surface Preparation: Clean and prepare surfaces to be coated according to the manufacturer's instructions

SPECIAL COATINGS

for each particular substrate condition and as specified.

Provide barrier coats over incompatible primers, or remove and reprime. Notify the Contracting Officer in writing of problems anticipated when using the specified finish-coat material with substrates primed by others.

Cementitious Surfaces: Prepare plaster, concrete masonry block and similar surfaces to receive special coatings. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen, as required, to remove glaze. If hardeners or sealers have been used to improve concrete curing, use mechanical methods to prepare surface.

Use abrasive blast-cleaning methods if recommended by the coating system manufacturer.

Determine alkalinity and moisture content of surfaces to be coated by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish coats to blister and burn, correct this condition before application. Do not apply coatings over surfaces where the moisture content exceeds that permitted in the manufacturer's printed directions.

Ferrous Metal: Clean ungalvanized ferrous metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale and other foreign substances. Use solvent or mechanical cleaning methods that comply with the recommendations of the Steel Structures Painting Council.

Touch-up shop-applied prime coats that have been damaged and bare areas. Wire-brush, solvent clean, and touch-up with the same primer as the shop coat.

Nonferrous Metal Surfaces: Clean nonferrous and galvanized surfaces according to the manufacturer's instructions for the type of service, metal substrate, and application required.

Material Preparation: Carefully mix and prepare materials according to the coating manufacturer's directions.

Stir materials before applying to produce a mixture of uniform density; stir as required during application. Do not stir surface film into the material. Remove film and, if necessary, strain the coating material before using.

Use only the type of thinners approved by the manufacturer and only within recommended limits.

Tinting: Tint each undercoat a lighter shade to facilitate identifying each coat where multiple coats of the same material are to be applied. Tint undercoats to match the color of the finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

APPLICATION

General: Apply special coatings by brush, roller, spray, or other applicators according to the manufacturer's directions. Use brushes best suited for the material being applied. Use rollers of carpet,

velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

Provide finish coats compatible with the primers used.

The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Where sanding is required, according to the manufacturer's directions, sand between applications to produce a smooth, even surface.

When undercoats or other conditions show through the final coat, apply additional coats until the cured film has a uniform coating finish, color, and appearance. Give special attention to edges, corners, crevices, welds, exposed fasteners, and similar surfaces to ensure that they receive a dry film thickness equivalent to that of flat surfaces.

The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, surface-mounted conduits and piping, electrical panels and switches, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces.

Coat the backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

Omit primer on metal surfaces that have been shop-primed and touch-up painted.

Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.

Allow sufficient drying time between successive coats. Do not recoat until the coating has dried so it feels firm and does not deform or feel sticky under moderate thumb pressure and where applying another coat does not cause the undercoat to lift or lose adhesion.

Minimum Coating Thickness: Apply each material no thinner than the manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by the manufacturer.

Block Fillers: Apply block fillers to exposed concrete surfaces and concrete masonry block at a rate to ensure complete coverage with pores completely filled.

Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to the material required to be coated or finished that has not been prime-coated by others.

Recoat primed and sealed substrates where there is evidence of suction spots or unsealed areas in

the first coat to ensure a finish coat with no burn-through or other defects caused by insufficient sealing.

Brush Application: Brush-out and work brush coats into surfaces in an even film. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.

Apply primers and first coats by brush unless the manufacturer's instructions permit using mechanical applicators.

Mechanical Applications: Use mechanical methods to apply coating when permitted by the manufacturer's recommendations and governing regulations.

Wherever using spray application, apply each coat to provide the equivalent hiding of brush-applied coats. Do not double-back with spray equipment building-up film thickness of two coats in one pass, unless recommended by the manufacturer.

Completed Work: Match approved samples for color, texture and coverage. Remove, refinish, or recoat work not complying with specified requirements.

CLEANING

Cleanup: At the end of each workday, remove rubbish, empty cans, rags, and other discarded materials from the site.

PROTECTION

Protect work of other trades, whether being coated or not, against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as acceptable to the Contracting Officer. Leave in an undamaged condition.

Provide "Wet Paint" signs to protect newly coated finishes. Remove temporary protective wrappings provided by others to protect their work after completing coating operations.

At completion of other trades' construction activities, touch up and restore damaged or defaced coated surfaces.

INTERIOR SPECIAL COATING SCHEDULE

Provide the following coating systems for substrates indicated:

Where undercoats or other conditions show through final coat, apply additional coats until the cured film is of uniform coating finish, color, and appearance.

Concrete Masonry Units:

Two-Component, High-Performance, Polyamide-Epoxy Coating with High Gloss Finish: Provide two finish coats of High-Performance Coatings over concrete masonry block filler.

Filler Coat: Concrete masonry block filler.

PPG: 97-685/97-686 Aquapon Polyamide-Epoxy Block Filler.
Sherwin Williams: B42W46 Heavy-Duty Block Filler.
Tnemec: 54-660 Epoxy-Polyamide Masonry Filler.

First and Second Coats: High Gloss, High-Performance, Polyamide-Epoxy Coating.

PPG: Aquapon Polyamide-Epoxy 97 Series Ready-mix Colors or Bases.
Sherwin Williams: Tile-Clad II Epoxy.
Tnemec: Series 66 Hi-Build Epoxoline.

Gypsum Board and Plaster:

Two-Component, High-Performance, Polyamide-Epoxy Coating with High Gloss finish: Provide two finish coats of High-Performance Coatings over pigmented primer/sealer coat.

Primer/Sealer coat: (1st Coat)

PPG: Speedhide Alkali Resistant Primer 6-3.
Sherwin Williams: Tile-Clad High-Build Primer.
Tnemec: Series 66-1255 Beige H.B. Epoxoline.

Finish Coats: (2nd. & 3rd. Coats) (2 Coats required over Primer/Sealer).

PPG: Aquapon Polyamide-Epoxy 97 Series Ready-mix Colors or Bases.
Sherwin Williams: Tile-Clad II Epoxy.
Tnemec: Series 66 - (Color as selected) H.B. Epoxoline.

Ferrous Metals:

Two-Component, High-Performance, Polyamide-Epoxy Coating with High Gloss Finish: Provide two finish coats of High-Performance Coatings over pigmented rust-inhibitive alkyd metal primer coat.

Primer: (1st Coat) (This coat is not required on items that are properly shop primed per Manufacturer's recommendations).

PPG: Rust-Inhibitive Metal Primer 6-208 or 6-212.
Sherwin Williams: Tile-Clad II Hi-Build Primer.
Tnemec: Series 66-1211 Epoxoline Primer.

Finish Coats: (2nd. & 3rd Coats) (2 Coats required over Primer).

PPG: Aquapon Polyamide-Epoxy 97 Series Ready-mix Colors or Bases.

Sherwin Williams: Tile-Clad II Epoxy.

Tnemec: Series 66 H.B Epoxoline.

Galvanized (zinc-Coated) Metal:

Two-Component, High-Performance, Polyamide-Epoxy Coating with High Gloss Finish: Provide two finish coats of High-Performance Coatings over prepared surface and/or primer as recommended by the Manufacturer of Finish Coats.

Preparation Coat: (1st Coat)

Solvent clean and etch all galvanized surfaces with GALVAPREP #5, POLYCLUTCH 97 Series Wash Primer, or other approved Phosphoric Acid solution treatments.

Finish Coats: (2nd. & 3rd Coats)

PPG: Aquapon Polyamide-Epoxy 97 Series Ready-mix Colors or Bases.

Sherwin Williams: Tile-Clad II Epoxy.

Tnemec: Series 66 H.B. Epoxoline.

END OF SECTION 09800

SECTION 09805 - ENCAPSULATION

PART 1 - GENERAL

1.0 RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Special Contract Conditions and other Specification sections, apply to this Section.

1.1 SECTION INCLUDES:

Detailed criteria for encapsulation/sealing of all surfaces from which asbestos-containing material has been removed.

1.2 RELATED SECTIONS:

- A. 01711 Project Decontamination - Asbestos
- B. 02081 Removal of Asbestos Containing Materials

1.3 SUBMITTALS:

- A. Furnish manufacturer's data (MSDS) for encapsulants proposed for use.
- B. Provide shop drawings indicating extent and methods proposed for use. Do not use until shop drawings have been accepted by the Project Manager.

1.4 DELIVERY AND STORAGE:

- A. Deliver all materials in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name.
- B. Store all materials that are subject to damage off the ground, away from wet or damp surfaces, and under cover sufficient to prevent damage or contamination.
- B. Damaged or deteriorating materials shall not be used and shall be removed from the premises. Material that becomes contaminated with asbestos shall be disposed of in accordance with the applicable regulations. New materials shall be paid for by the Contractor at no cost to the Owner.

PART 2 - PRODUCTS

2.0 MATERIALS:

- A. All encapsulant/sealants applied pursuant to this Contract shall have received an "acceptable" rating in the tests by Battelle Columbus Laboratories for the EPA (copies

of this report are available from the Project Manager) or shall exhibit similar characteristics in independent tests.

B. Encapsulant/sealants shall have the following characteristics:

1. Class "A" fire rating.
2. Less than 50% opacity resulting from smoke generation in both the flame and the flow-wire smoke generation tests.
3. Toxic gas releases as a result of burning shall be less than the "potentially hazardous" levels as defined by OSHA or NIOSH threshold limit values.
4. Good surface integrity capable of sealing the surface from which asbestos-containing material has been removed.

PART 3 - EXECUTION

3.0 PERFORMANCE:

Encapsulant /Lockdown

For all surfaces from which asbestos-containing material is removed, the Contractor shall perform the encapsulation/sealing in such a way that a permanent continuous sealed surface is achieved. During encapsulation/sealing any active automated fire detection devices shall be turned off, if the encapsulation/sealing agent is likely to impair efficiency or damage the equipment.

3.1 PREPARATION AND APPLICATION:

- A. The encapsulant/sealant shall be prepared and applied according to the manufacturer's specifications, using manufacturer approved airless spraying equipment. Because application by spraying could cause dissemination of residual fibers, the encapsulant/sealant must be applied with as much caution and at as low a nozzle pressure as possible.
- B. The encapsulant/sealant shall be applied in one uniform coat with touching up as required.

END OF SECTION 09805

SECTION 09900 - PAINTING

PART 1 - GENERAL

SUMMARY

This Section includes surface preparation, painting and finishing of exposed interior and exterior items and surfaces.

Surface preparation, priming and finish coats specified in this section are in addition to shop-priming and surface treatment specified under other sections of work.

Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Contracting Officer will select from Vision 2000 Standards.

Painting includes field painting interior and exterior exposed bare and covered pipes and ducts, hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

All items on the roof, whether aluminum or otherwise, are required to be painted.

Painting, unless otherwise indicated, is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.

Prefinished items not to be painted, unless otherwise indicated, include the following factory-finished components:

- Metal toilet partitions.
- Finished mechanical and electrical equipment.
- Light fixtures.

Concealed surfaces not to be painted, unless otherwise indicated, include wall or ceiling surfaces in the following generally inaccessible areas:

- Furred areas.
- Pipe spaces.
- Duct shafts.

Finished metal surfaces not to be painted, unless otherwise indicated, include:

- Anodized aluminum.
- Stainless steel.
- Chromium plate.
- Copper.

Bronze.
Brass.

Operating parts not to be painted, unless otherwise indicated, include moving parts of operating equipment such as the following:

Valve and damper operators.
Linkages.
Sensing devices.
Motor and fan shafts.

Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

Related Sections: The following sections contain requirements that relate to this section:

Division 5 Sections for shop priming structural steel, joists and ferrous metal.

Division 8 Section "Standard Steel Doors and Frames" for shop priming steel doors and frames.

Division 9 Section "Special Coatings" for interior special coating applications.

DEFINITIONS

"Paint" includes coating systems materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

SUBMITTALS

Product Data: Manufacturer's technical information, label analysis and application instructions for each material proposed for use.

List each material and cross-reference the specific coating and finish system and application.

Identify each material by the manufacturer's catalog number and general classification.

Samples: For initial color selection in the form of manufacturer's color charts.

After color selection, the Contracting Officer will furnish a color schedule for surfaces to be coated.

Samples for verification purposes: Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate. Define each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.

Provide a list of material and application for each coat of each samples. Label each samples as to location and application.

QUALITY ASSURANCE

Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

Notify the Contracting Officer of problems anticipated using the materials specified.

Material Quality: Provide the manufacturer's best quality paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

DELIVERY, STORAGE AND HANDLING

Deliver materials to job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and following information:

- Product Name or title of material.
- Product description (generic classification or binder type).
- Federal Specification number, if applicable.
- Manufacturer's stock number and date of manufacture.
- Contents by volume, for major pigment and vehicle constituents.
- Application instructions.
- Color name and number.

Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45°F (7°C). Maintain containers used in storage in a clean condition, free of foreign materials and residue. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

JOB CONDITIONS

Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50°F (10°C) and 90°F (32°C), unless otherwise permitted by paint manufacturer's printed instructions.

PAINTING

Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45°F (7°C) and 95°F (35°C), unless otherwise permitted by paint manufacturer's printed instructions.

Do not apply paint in snow, rain, fog or mist; or when relative humidity exceeds 85 percent; or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.

Painting may continue during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

All painting shall be done in favorable lighting conditions.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide products of one of the following:

The Glidden Company (Glidden).
Benjamin Moore and Co. (Moore).
PPG Industries, Pittsburgh Paints (Pittsburgh).
Pratt and Lambert (P & L).
The Sherwin-Williams Company (S-W).
Porter Paint Co. (Porter).

MATERIALS

Material Quality: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.

Federal Specifications establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provided meet or exceed these minimums. Manufacturer's products which comply with coating qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to Contracting Officer. Furnish material data and manufacturer's certificate of performance to Contracting Officer for any proposed substitutions.

Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

PART 3 - EXECUTION

COLORS AND FINISHES

Prior to beginning work, the Contracting Officer will furnish color selections for surfaces to be painted.

Use computer matching colors when preparing samples for review.

Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify Contracting Officer in writing of any anticipated problems using specified coating systems with substrates primed by others.

EXAMINATION:

Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.

Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within any particular area.

Do not paint over dirt, rust, scale, grease, moisture, imperfections, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

PREPARATION

General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from cleaning process will not fall on wet, newly painted surfaces.

Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

Provide barrier coats over incompatible primes or remove and re-prime. Notify Contracting Officer in

PAINTING

writing of problems anticipated with using specified finish-coat material with substrates primed by others.

Cementitious Materials: Prepare cementitious surfaces of concrete and concrete block to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.

Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

Wood: Clean surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer before application of primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sandpaper smooth when dried.

Prime, stain, or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, and paneling.

Seal tops, bottoms, and cut-outs of unprimed wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery of job.

Ferrous Metals: Clean non-galvanized ferrous-metal surfaces, that have not been shop-coated; remove oil, grease, dirt, loose mill scale and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.

Touch-up bare areas and shop-applied coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch-up with same primer as the shop coat.

Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.

Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

Use only thinners approved by the paint manufacturer, and only within recommended limits.

Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

APPLICATION

Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

Provide finish coats that are compatible with primers used.

The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.

Apply additional coats when undercoats or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

The term "exposed surfaces" includes areas visible when permanent of built-in fixtures, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.

Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.

Heating and A/C grilles and registers including their cores shall be sprayed to match wall and ceiling color as directed.

Paint interior surfaces of ducts, where visible through registers or grille with a flat, non-specular black paint.

Paint both sides of access panels and removable or hinged covers to match exposed surfaces.

Paint all metal fire extinguisher cabinets located in a finished wall as directed by the Contracting Officer.

Finish doors on tops, bottoms, and side edges same as faces.

Sand lightly between each succeeding enamel coat.

PAINTING

Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.

Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

Interior painted surfaces will be judged on final appearance only rather than the additional requirements of individual coat mil thickness.

Mechanical and Electrical Work: Painting mechanical and electrical work is limited to exposed items in equipment rooms and in occupied spaces and on the exterior of the building.

Mechanical items to be painted include but are not limited to:

- Piping, pipe hangers, supports.
- Heat exchangers.
- Tanks.
- Ductwork.
- Insulation.
- Supports.
- Motors, mechanical equipment and supports.
- Accessory items.

Electrical items to be painted include but are not limited to:

- Exterior items such as transformers.
- Electrical panel covers and boxes.
- Conduit and fittings.
- Switchgear.
- Exposed electrical ducts, troughs, plug molds, etc.

Prime Coat: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.

Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

FIELD QUALITY CONTROL

The Government reserves the right to invoke the following test procedure at any time and as often as the Government deems it necessary during the period when paint is being applied:

The Government may engage the services of an independent testing laboratory to sample the paint material being used. Samples of material delivered to the project will be taken, identified, sealed, and certified in the presence of the Contractor.

If test results show material being used does not comply with specified requirements, the Contractor may be directed to stop painting, remove non-complying paint, pay for testing, repaint surfaces coated with rejected paint, and remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non-compatible.

CLEANING

Clean-up: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

Upon completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

PROTECTION

Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Contracting Officer.

Provide "Wet Paint" signs to newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

At the completion of construction activities of other trades, touch-up and restore all damaged or defaced painted surfaces.

EXTERIOR PAINT SCHEDULE

General: Provide the following paint systems for the various substrates indicated.

Ferrous Metal: Primer is not required on shop-primed items.

High-Gloss Alkyd Enamel: 2 finish coats over primer.

Primer: Synthetic Rust-Inhibiting Primer. (DFT 1.3 mils minimum)
First Coat: High-Gloss Alkyd Enamel. (DFT 3.0 mils minimum)
Second Coat: High-Gloss Alkyd Enamel. (DFT 3.0 mils minimum)

Zinc-Coated Metal:

High-Gloss Alkyd Enamel: 2 finish coats over primer and preparatory coat.

Preparatory Coat: Phosphoric acid solution equal to GALVAPREP #5.

Primer: Galvanized Metal Primer. (DFT 1.2 mils minimum)
First Coat: High-Gloss Alkyd Enamel. (DFT 2.6 mils minimum)
Second Coat: High-Gloss Alkyd Enamel. (DFT 2.6 mils minimum)

Aluminum:

High-Gloss Alkyd Enamel: 2 finish coats over primer.

Primer: Alkyd-type Zinc Chromate Primer. (DFT 1.4 mils minimum)
First Coat: Alkyd High-Gloss Enamel. (DFT 2.6 mils minimum)
Second Coat: Alkyd High-Gloss Enamel. (DFT 2.6 mils minimum)

INTERIOR PAINT SCHEDULE

General: Provide the following paint systems for the various substrates as indicated:

Concrete and Concrete Masonry Units:

1st Coat: Surface Block Filler. (See note below) (DFT 5.0 mils minimum)
2nd Coat: Interior Low-Luster Satin Latex Wall Paint. (DFT 2.8 mils minimum)
3rd Coat: Interior Low-Luster Satin Latex Wall Paint. (DFT 2.8 mils minimum)

Apply filler coat at a rate to ensure complete coverage with pores filled to obtain a stipple finish with paint coatings.

Gypsum Drywall Systems:

1st Coat: - Interior Latex Base Primer Coat. (DFT 1.2 mils minimum)
2nd Coat: - Interior Low-Luster Satin Latex Wall Paint. (DFT 2.8 mils minimum)
3rd Coat: - Interior Low-Luster Satin Latex Wall Paint. (DFT 2.8 mils minimum)

Aluminum: (Only where indicated to be painted).

- 1st Coat: - Universal Metal Primer. (DFT 1.2 mils minimum)
- 2nd Coat: - Semi-Gloss Alkyd Enamel. (DFT 1.4 mils minimum)
- 3rd Coat: - Semi-Gloss Alkyd Enamel. (DFT 1.4 mils minimum)

Ferrous Metal:

- 1st Coat: - Synthetic Rust-Inhibiting Primer. (DFT 1.5 mils minimum)
 - 2nd Coat: - Semi-Gloss Alkyd Enamel. (DFT 1.4 mils minimum)
 - 3rd Coat: - Semi-Gloss Alkyd Enamel. (DFT 1.4 mils minimum)
- First coat not required on items that are shop primed.

Zinc-Coated Metal:

- 1st Coat: - Phosphoric acid solution equal to Galvaprep #5.
- 2nd Coat: - Zinc Dust-Zinc Oxide Primer. (DFT 1.2 mils minimum)
- 3rd Coat: - Enamel Undercoat. (DFT 1.2 mils minimum)
- 4th Coat: - Semi-Gloss Alkyd Enamel. (DFT 1.4 mils minimum)

Opaque Woodwork:

- 1st Coat: - Interior Enamel Undercoat. (DFT 1.2 mils minimum)
- 2nd Coat: - Odorless Interior Semi-Gloss Enamel. (DFT 2.6 mils minimum)
- 3rd Coat: - Odorless Interior Semi-Gloss Enamel. (DFT 2.6 mils minimum)

Stained Woodwork:

Stained Varnish Satin Finish: 3 finish coats over stain plus filler on open-grain wood. Wipe filler before applying first varnish coat.

- Stain Coat: Oil-type Interior Wood Stain. (Spreading rate as recommended by mfgr.)
- First Coat: Sanding Sealer. (Spreading rate as recommended by mfgr.)
- Filler Coat: Paste Wood Filler. (Spreading rate as recommended by mfgr.)
- Second Coat: Oil Base Satin Varnish. (Spreading rate as recommended by mfgr.)
- Third Coat: Oil Base Satin Varnish. (Spreading rate as recommended by mfgr.)

Exposed Structure, including but not limited to structural steel, girts, joists, girders, metal deck, and miscellaneous exposed steel:

Apply one (1) coat over shop primer equal to Porter Paints,
"Dry Fog White #36424". (DFT 1.5 mils minimum)

Walls, panels, glass & glazing shall be protected from overspray.

Cotton or Canvas Covering Over Insulation on Piping and Ductwork:

1st (size) Coat: - Interior Latex Emulsion. (Spreading rate as recommended by mfgr.)
2nd Coat: - Interior Latex Emulsion. (Spreading rate as recommended by mfgr.)
Add fungicidal agent to render fabric mildew-proof.

END OF SECTION 09900

SECTION 09911- REFLECTIVE CHEMICALLY RESISTANT URETHANE (CRU) FLOOR COATING

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes applying reflective chemically resistant urethane floor coatings, including surface preparation where shown on the plan.

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

Division 3 Section "Cast-in-Place Concrete" for curing compounds.

SUBMITTALS

General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

Product data for each coating system specified, including primers.

Provide the manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each material proposed for use.

List each material and cross-reference the specific coating, finish system, and application. Identify each material by the manufacturer's catalog number and general classification.

Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

Samples for initial color selection in the form of manufacturer's color charts.

Complete surface preparation and application instructions prepared by the manufacturer of the reflective coating system.

List of safety items and safety precautions to be used at the jobsite.

Identification of Technical Representative: A letter from the manufacturer of the reflective coating system designating a technical representative that would be available for a pre-installation conference and designating a technical representative that will be on the job at all times during the execution of the Work.

QUALITY ASSURANCE

Applicator Qualifications: Engage an experienced applicator with minimum 5 years experience, who has successfully completed coating system applications similar in material and extent to those indicated for the Project.

Single-Source Responsibility: Provide products manufactured by the same manufacturer.

Coordination of Work: Review sections in which other coatings and curing compounds are provided to ensure compatibility of the total systems for various substrates. Upon request, furnish information on characteristics of specified finish materials, to ensure that compatible prime coats are used.

Notify the Contracting Officer of problems anticipated using the coating systems specified.

Comply with the following Standards:

Federal Specifications (Fed. Spec.):

TTP-141-B

American Society for Testing and Materials (ASTM) Publications:

ASTM D882-67

ASTM C501-62T

29 CFR Occupational Safety and Health Standards 1910.134

Military Specification:

MIL-H-83282B Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, NATO Code Number H-537

Technical Representative: The Contractor shall be responsible for, and shall pay for, the presence of a Technical Representative of the manufacturer of the reflective coating system during all floor preparation and coating application operations. The Technical Representative shall assure and certify that proper techniques are followed in accordance with the manufacturer's recommendations, including proper surface preparation, moisture in the concrete, mixing of coatings, quantity of coating applied, cure time prior to recoating, and distribution of grit.

Safety Provisions: The Contractor shall provide health and fire safety precautions for his own personnel, and shall conduct his operations in coordination with station operations so that no station

personnel are exposed to hazardous amounts of solvent vapors. During coating application, the following shall be required unless in conflict with a manufacturer's recommendations or other requirements of a recognized legal authority, in which case those requirements take precedence.

Protection Against Vapors: Wear canister-type or fresh air supply masks when applying coatings

in a confined location, when spraying coatings, or when handling hazardous liquid materials. Respiratory protective services shall be as recommended by OSHA 1910.134 and approved by the Mining Enforcement and Safety Administration or be acceptable to the U.S. Department of Labor for the specific contaminant to which a person is exposed. Instruct personnel required to use respiratory protective devices in their use and provide adequate supply of replacement cartridges. Maintain such equipment and inspect regularly.

Protection Against Liquids: When applying coatings or when handling hazardous liquid materials, wear protective clothing and gloves and use eye and face protection. Face protective equipment shall meet the requirements of ANSI Z87.1.

DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered to the jobsite in the factory sealed containers in sufficient quantity to allow continuity of work and shall be stored in dry locations, protected from the weather. The containers shall be clearly labeled with the manufacturer's name, product identification, shelf life, and lot number, and they shall be stored so as to permit access for inspection and handling.

PROJECT CONDITIONS

Coating application shall not be started unless the slab temperature is not less than 65 degrees F nor more than 90 degrees F. If the application must be performed under other environmental conditions, a statement from the coating manufacturer shall be submitted, which certifies that these environmental conditions are acceptable.

PART 2 - PRODUCTS

COATING SYSTEM

The reflective chemically resistant urethane (CRU) floor coating system shall be as manufactured by the Tennant Company and as follows:

- Removal of all paint, oil and grease
- Acid etch (non-muriatic acid)
- Coat 1 406 Epoxy primer
- Coat 2 4707 Light Gray CRU (or alternate color as selected by Contracting Officer)
- Grit 292 Safewalk Grit - (Broadcast on wet second coat)
- Coat 3 4707 Light Gray CRU (or alternate color as selected by Contracting Officer)

The system components shall be applied in the sequence shown and by methods further described in Part 3, below. The complete reflective coating system, including all preparation materials, coatings and the grit, shall be supplied by the same manufacturer. Only the specified 292 Safewalk Grit shall be used; no sand or other silica grit shall be used.

Colors: Provide color selections made by the Contracting Officer from the manufacturer's full range of

colors.

COATING PROPERTIES

The topcoat and intermediate coat shall be Tennant 4707 Light Gray (or alternate color as selected by Contracting Officer) Chemical Resistance Urethane, and without grit they shall have properties that meet the following physical properties:

COATING PROPERTIES (AT 75 - 77 DEGREES F, 50% RELATIVE HUMIDITY)

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>RESULTS</u>
a. Tensile Strength	ASTM D882-67	9,000 PSI
b. Elongation	ASTM D882-67	20%
c. Abrasion Resistance	Taber Index ASTM D658 ASTM C501-62T CS-17 Abrasion Wheel	50-60mg loss
d. Hardness, Sward	1 Mil Film on Glass	24 hrs. - 32 48 hrs. - 40 2 weeks - 52
e. Percent Solids	Federal Spec. TTP-141B Method 4041	Part A 68.1% Part B 52.7%
f. Viscosity	Brookfield TCL 720-1 Gardner-Holdt TCL 710-1	Part A-180-240cps Part B-A2-A3
g. Density	Federal Spec. TTP 141B Method 4184	Part A-13.9 lbs/gal 1.7 kg/ltr Part B- 8.65 lbs/gal 1.0 kg/ltr
h. Flash Point	Seta Flash Closed Cup	Part A: 108° F Part B: 110° F
i. L.A. Rule 66		Complies

The CRU coating shall meet the following recommendations for use:

RECOMMENDATION CHART FOR REFLECTIVE
CHEMICAL RESISTANT URETHANE SYSTEM

	C	I
ACIDS, INORGANIC		
27% Hydrochloric Acid (Muriatic)	X	
10% Nitric Acid	N	X
ACIDS, INORGANIC (Continued)		
37% Sulfuric Acid (Battery Acid)	X	
50% Phosphoric Acid	X	
ACIDS, ORGANIC		
10% Acetic Acid	X	
10% Citric Acid	X	
100% Oleic Acid	X	
ALKALIES		
10% Ammonium Hydroxide	X	
50% Sodium Hydroxide	X	
SALTS		
20% Sodium Chloride	X	
20% Ammonium Nitrate	X	
10% Trisodium Phosphate	X	
1% Chlorinated Lime	X	
SOLVENTS (ALCOHOLS)		
Methyl Alcohol	X	
Ethylene Glycol	X	
Isopropyl Alcohol	X	
SOLVENTS (ALIPHATIC)		
Gasoline	X	
Turpentine	X	
JP-4 (Jet Fuel)	X	

SOLVENTS (AROMATIC)

Benzene	X
Toluol	X

SOLVENTS (CHLORINATED)

Trichloroethylene	X
Methylene Chloride	X

SOLVENTS (KETONES AND ESTERS)

Acetone	X
MEK	X
Cellosolve Acetate	X

MISCELLANEOUS CHEMICALS

Skydrol 500B	X
Freon - 11	X
Brake Fluid	X

- C - Continuous Exposure-Periodic flushing with water recommended
- I - Intermittent Exposure-Periodic flushing with water recommended
- X - Recommended
- N - Not Recommended

MISCELLANEOUS MATERIALS

General: All materials required to complete the Contract shall be furnished by the Contractor. All coatings, chemicals, and sealants that are used shall be products that are approved by the manufacturer of the reflective coating system.

Materials for Surface Preparation: Various chemicals are used in the surface preparation of the concrete prior to coating application, as further described in Part 3. These include detergents for cleaning, solvents for oil and grease removal, and acids for etching of the surface.

Materials for Sealing of Joints: Joint sealants shall be either 405 Water Epoxy (Clear) or 406 Water Epoxy (white pigmented) or an epoxy material that is solvent resistant and approved by the manufacturer's technical representative.

Striping Coatings: Traffic markings and other striping coatings shall be 424 High Wear moisture-cured urethane coatings in the colors as selected by Contracting Officer. (Traffic marking paints for roads or runways are not acceptable.)

PART 3 - EXECUTION

EXAMINATION

Examine substrates and conditions under which coatings will be applied for compliance with requirements on applying coatings. Surfaces to receive coatings must be thoroughly dry before coatings are applied.

Do not proceed with coating application until unsatisfactory conditions have been corrected.

Start of application will be construed as the Applicator's acceptance of surfaces within that particular area.

PREPARATION

General: The Contractor shall thoroughly clean all surfaces to be coated, and where necessary shall repair them, before application of the coating system. The Contractor shall be responsible for correcting any damage to the concrete floor during the surface preparation. The surface preparation instructions of the manufacturer of the reflective coating system shall be followed.

Cleaning of Floor: The floor shall be swept and freed of debris and shall be cleaned with a mechanical scrubber and a heavy-duty detergent. The floor will then be scrubbed while it is rinsed with water.

Removal of Surface Contaminants: Raised areas on the floor, such as extraneous mortar or caked on material, shall be removed mechanically. Any existing paint or coatings shall be removed by mechanical means (K-4 Scarifier with a 12 stage tool or 510 stripper) at the recommendation of the Technical Representative. Any coating remaining on the floor because of the rough texture of the concrete shall be brushed with abrasive tipped or stiff wire bristle brushes in the direction of the concrete texture, until all shininess is removed.

Removal of Absorbed Contaminants: The concrete floor surface shall be made free of any oil or grease or similar contaminants with a mixture of 528 Cleaner Remover and solvents (or 531 Remover) and surface active agents designed to remove these contaminants. The cleaning mixture shall soak for 20 minutes before being scrubbed with added detergent, and the floor shall be scrubbed while being rinsed with water. If the floor is not readily wetted by water after the above operation, the procedure shall be repeated as often as necessary. Special attention shall be given to the control joints, as indicated below.

Preparation of Control Joints: Fill joints with urethane sealant as recommended by floor coating manufacturer.

Etching of Concrete: The clean concrete surface shall be etched with a diluted solution of 409 Pre Kote Cleaner (not hydrochloric [muriatic] acid) or an organic acid, according to the reflective coating manufacturer's recommendation. When using 409 Pre Kote Cleaner, the reaction of the acid should be gentle to form small bubbles and it should be uniform. Where the acid does not properly wet the floor and fails to form bubbles, contaminants shall again be removed according to procedure described under "Removal of Surface Contaminants" above, and this procedure shall be repeated until the concrete is properly cleaned. The acid shall be allowed to stand on the floor for five minutes to complete the reaction.

The floor shall then be scrubbed with detergent and rinsed thoroughly to remove all residue, while flooding with fresh water. From the beginning of the etching process until the final water rinsing, no portions of the floor shall be allowed to dry. After the completion of rinsing, the water shall be removed by vacuum pickup, or with squeegees and damp mops if necessary, insuring that the water is removed from all depressions, including control joints. The surface of the concrete should be at least as rough as fine sandpaper; where it is too smooth, the etching process shall be repeated. The floor shall be dried overnight or as recommended by the reflective coating manufacturer.

Masking of Adjacent Areas: The Contractor shall provide and install masking tape or other protective materials for adjacent areas that should not be painted, including static grounding points, drainage gratings, etc.

COATING SYTEM APPLICATION

The Contractor shall apply the coating system in accordance with the instructions of the manufacturer of the reflective coating system.

Curing and Moisture Content: Concrete shall be cured for a minimum of 30 days prior to application of coating. Contractor shall test and verify that moisture content does not exceed 22 on the Delmhorst moisture meter reading using the probe and scale intended for wood, before application of coating.

Application of Primer and Topcoats: Two-component coatings shall be completely mixed prior to application, and any pigmented component shall be mixed separately before the hardener, activator, catalyst, or Part B is added. No more material shall be mixed than can be used in a 3-hour period. A 10-minute induction period shall be allowed before the mixed coating is applied. No thinner shall be added. The mixed coating shall be applied with a medium nap roller or other suitable approved method. All coats shall be cut fully to edges, around pipes, structural supports, conduits, and other items not to be coated. The manufacturer's minimum recommended drying times shall be observed. If any coat dries more than 24 hours before recoating, the surface shall be buffed with No. 1 steel wool or with No. 100 sandpaper and shall be vacuumed or swept thoroughly before recoating.

After applying prime coat of urethane, any holes in the concrete finish greater than 3/8" shall be filled with manufacturer's recommended filler product. Surface shall be reviewed and approved by the government prior to further application.

Grit Application: Grit that is broadcast shall be uniformly distributed with a mechanical seeding device, such as a "Whirley Bird". Care shall be taken that the seeder blades move uniformly, the seeder is held horizontally, and the seeder is at least one third full when grit is dispensed, and that residues in the seeder are not dropped on the coating. It will be applied at the rate as required by the end user or at a rate of 10 pounds per 1,000 square feet. (Personnel using golf shoes for this operation should be reminded that these are very slippery on the freshly coated floor).

Final Curing: After all the coats of the system have been applied, the final coat shall dry 12 hours before light foot traffic is allowed and 24 hours before general foot traffic is allowed, and additional time may be required for marking coatings. Complete curing may require 2 weeks, during which time special care

should be taken not to drag objects on the floor. Aircraft wheels or other heavily loaded wheels or skids should be placed on plywood sheets if they remain stationary for several hours. The Contractor shall protect the coated surfaces until the work is completed, and shall inform the Contracting Officer about the curing requirements as they apply to the coating system and the traffic markings.

TRAFFIC MARKINGS

After the final coat has dried 24 hours, traffic lanes, fire lanes, static grounding point markings, etc., shall be installed. Masking tape shall be used to delineate such lines or areas. If the final coat has dried more than 48 hours, the area to be marked shall be buffed with No. 1 steel wool to provide a good bond. One coat of each required color shall be applied.

CLEANING

Cleanup: At the end of each work day, remove rubbish, empty cans, rags, and other discarded materials from the site.

PROTECTION

Protect work of other trades, whether being coated or not, against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as acceptable to the Contracting Officer. Leave in an undamaged condition.

Provide "Wet Paint" signs to protect newly coated finishes. Remove temporary protective wrappings provided by others to protect their work after completing coating operations.

At completion of other trades' construction activities, touch up and restore damaged or defaced coated surfaces.

The Contractor shall remove from the premises liquid waste material from cleaning operations that cannot be safely flushed into the sewer systems and shall remove from the premises coating or solvent residues and containers.

END OF SECTION 09911

SECTION 10100 - VISUAL DISPLAY BOARDS AND CASES

PART 1 - GENERAL

RELATED DOCUMENTS:

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

SUMMARY:

This section includes the following types of visual display boards:

- Porcelain enamel markerboards (for liquid chalk).
- Vinyl-fabric-faced cork tackboards.
- Display cases

Related Sections: The following sections contain requirements that relate to this section:

- Division 6 Section "Rough Carpentry" for wood blocking and grounds.

SUBMITTALS:

Shop Drawings: Provide shop drawings for each type of markerboard and tackboard required. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

Samples: Provide the following samples of each product for initial selection of colors, patterns, and textures.

- Porcelain Enamel Markerboard: Manufacturer's color charts consisting of actual sections of porcelain enamel finish showing the full range of colors available for each type of markerboard indicated.

- Vinyl-fabric-faced Cork Tackboards: Manufacturer's color charts consisting of actual sections of vinyl fabric, showing the full range of colors, textures, and patterns available for each type of vinyl-fabric-faced cork tackboard indicated.

- Aluminum Trim and Accessories: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch square of sheet or plate, showing the full range of colors available.

QUALITY ASSURANCE:

Fire Performance Characteristics: Provide vinyl-fabric-faced tackboards with surface burning characteristics indicated below, as determined by testing assembled materials composed of facings and backings identical to those required in this section, in accordance with ASTM E 84, by a testing organization acceptable to authorities having jurisdiction.

Flame Spread: 25 or less.

Smoke Developed: 10 or less.

PROJECT CONDITIONS:

Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 - PRODUCTS

MANUFACTURERS:

Manufacturer: Subject to compliance with requirements, provide products of one of the following:

Porcelain Enamel Markerboards:

Claridge Products and Equipment, Inc.
Greensteel, Inc.

Tackboards:

Claridge Products and Equipment, Inc., "Designer Series".
Greensteel, Inc., "Polyester/Landscape Series".

Display Cases:

Greensteel, Inc., "UX Series", without base.

MATERIALS:

Porcelain Enamel Markerboards: Provide balanced, high- pressure-laminated porcelain enamel markerboards of 3-ply construction consisting of face sheet, core material, and backing.

Face Sheet: Provide 24-gage, "Vitracite," porcelain enamel clad, Type 1 stretcher-leveled

aluminized steel face sheet, as manufactured by Claridge Products and Equipment, Inc. Fuse porcelain enamel coating to steel at approximately 1000°F (538°C).

Cover Coat for Markerboards: Provide the manufacturer's standard light-colored special writing surface with gloss finish intended for use with liquid felt-tipped markers.

Core: Provide the manufacturer's standard 3/8-inch-thick particleboard core material complying with the requirements of ANSI A208.1, Grade 1-M-1.

Backing Sheet: Provide the manufacturer's standard 0.005-inch thick aluminum foil backing.

Laminating Adhesive: Provide the manufacturer's standard moisture-resistant thermoplastic-type adhesive.

Display Case: Case shall be complete with red oak veneer panel at top and bottom; fixed 1/4" tempered safety glass sides; standards; brackets; and 1/4" tempered safety glass shelves. Rear walls shall be fabric equal to Greensteel, Inc., "Polyester/Landscape Series". Color as selected by Contracting Officer from manufacturer's full range of colors. All exposed metal shall be extruded aluminum 6063-T5 alloy, anodized dark bronze finish. Doors shall be 1/4" tempered safety glass with special extruded aluminum "H" molding at top and bottom and shall be provided with lock and key. Each door shall have finger slots. Doors shall slide smoothly, easily and quietly and shall have fiber wheels at the bottom and rubber guides at the top. Fluorescent light at top with 110V ballast is included.

Sizes as indicated on drawings.

Fabric-Faced Tackboards: Provide mildew-resistant, 100% polyester fabric, 18.5 ounces per lin. yd., with non-directional weave and "Class A" fire rating. Laminate fabric to 1/4 inch thick cork sheet. Provide color as selected by Architect from manufacturer's standard colors.

Backing: Make panels rigid by factory laminating 1/4" cork face sheet under pressure to 1/4-inch-thick hardboard backing.

ACCESSORIES:

Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch-thick aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units wherever possible; keep joints to a minimum. Miter corners to a neat, hairline closure.

Where the size of boards or other conditions exist that require support in addition to the normal trim, provide structural supports to modify the trim as indicated or as selected by the Contracting Officer from the manufacturer's standard structural support accessories to suit the condition indicated.

Field-Applied Trim: Provide the manufacturer's standard snap-on trim, with no visible screws or exposed joints.

Chalktray: Furnish manufacturer's standard continuous box-type aluminum chalktray with slanted front and cast aluminum end closures for each markerboard.

FABRICATION:

Porcelain Enamel Markerboards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.

Assembly: Provide factory-assembled markerboard and tackboard units, except where field-assembled units are required.

Make joints only where total length exceeds maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the board, as acceptable to the Contracting Officer.

Provide the manufacturer's standard vertical joint system between abutting sections of markerboard.

Provide manufacturer's standard mullion trim at joints between markerboard and tackboard.

FINISHES:

General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

Class II Color Anodized Finish: AA-M12C22A32/A34 (Mechanical Finish: As fabricated, non-specular; Chemical Finish: Etched, medium matte; Anodic Coating: Class II Architectural, clear film thicker than 0.4 mil with integral color or electrolytically deposited color).

Color: Dark bronze or as selected by the Contracting Officer.

PART 3 - EXECUTION

INSTALLATION:

Deliver factory-built markerboard and tackboard units completely assembled in one piece without joints, wherever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.

Install units in locations and at mounting heights indicated and in accordance with the manufacturer's instructions. Keep perimeter lines straight, plumb and level. Provide grounds, clips, backing materials,

adhesives, brackets, anchors, trim, and accessories necessary for a complete installation.

Coordinate job-site assembled units with grounds, trim, and accessories. Join parts with a neat, precise fit.

ADJUST AND CLEAN:

Verify that accessories required for each unit have been properly installed.

Clean units in accordance with the manufacturer's instructions.

Break in chalkboards only as recommended by the manufacturer.

END OF SECTION 10100

SECTION 10155 - TOILET COMPARTMENTS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Division 1 Specification Sections, apply to this section.

SUMMARY

Types of toilet compartments include:

Metal with baked enamel finish.

Styles of toilet compartments include:

Floor-anchored, overhead braced.

Styles of screens include:

Wall-hung.

Toilet accessories, such as toilet paper holders and grab bars are specified elsewhere in Division 10.

SUBMITTALS

Product Data: Submit manufacturer's detailed technical data for materials, fabrication, and installation, including catalog cuts of anchors, hardware, fastenings, and accessories.

Shop Drawings: Submit shop drawings for fabrication and erection of partition assemblies not fully described by product drawings, templates and instructions for installation of anchorage devices built into other work.

Samples: Submit full range of color samples of each type of unit required. Submit 6 inch x 6 inch samples of each color and finish on same substrate to be used in work, for color verification after selections have been made.

QUALITY ASSURANCE

Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, to ensure proper fitting of work. Allow for adjustments within specified tolerances.

Coordination: Furnish inserts and anchorages which must be built into other work for installation of toilet

compartments and related items. Coordinate delivery with other work to avoid delay.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide products of one of the following:

Steel-Baked Enamel Finish:

All American Metal Corp.
American Sanitary Partition Corp.
AMPCO Products, Inc.
Global Steel Products Corp.
Metpar Steel Products Corp.
Sanymetal Products Co.

MATERIALS

General: Provide materials which have been selected for surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are not acceptable.

Steel Sheets for Baked Enamel Finish: ASTM A 591, Class C, galvanized-bonderized, of following minimum thicknesses:

Pilaster (overhead-braced): 20 gage
Pilasters (unbraced): 18 gage
Panels and Screens: 20 gage
Doors: 22 gage

Concealed Anchorage Reinforcement: Minimum 12-gage galvanized steel sheet.

Concealed Tapping Reinforcement: Minimum 14-gage galvanized steel sheet.

Core Material for Metal Partitions: Manufacturer's standard sound-deadening honeycomb of impregnated Kraft paper, in thickness to provide finished dimension of 1" minimum for doors, panels, and screens; 1-1/4" minimum for pilasters.

Pilaster Shoes and Caps: ASTM A 167, Type 302/304 stainless steel, not less than 3" high, 20-gage, finished to match hardware.

Stirrup Brackets: Manufacturer's standard design for attaching panels to walls and pilasters, either

chromium-plated non-ferrous cast alloy ("Zamac") or anodized aluminum.

Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories of chromium-plated non-ferrous cast alloy ("Zamac").

Overhead Bracing: Continuous extruded aluminum, antigrip profile, with clear anodized finish.

Anchorage and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, chromium-plated steel, or brass finished to match hardware, with theft-resistant type heads and nuts. For concealed anchors, use hot-dip galvanized cadmium-plated, or other rust-resistant protective-coated steel.

FABRICATION

General: Furnish standard doors, panels, screens, and pilasters fabricated for compartment system, unless otherwise indicated. Furnish units with cutouts, drilled holes, and internal reinforcement to receive partition-mounted hardware, accessories, and grab bars, as indicated.

Doors Dimensions: Unless otherwise indicated, furnish 24" wide in-swinging doors for ordinary toilet stalls and 32" wide (clear opening) doors at stalls equipped for use by handicapped. Door swing for handicap stalls shall be as indicated on drawings.

METAL TOILET PARTITIONS AND SCREENS

General: Pressure laminate seamless face sheets to core materials and seal edges with continuous interlocking strips or with lapped and formed edges. Weld edges and corners, with exposed welds ground smooth.

Overhead-Braced Partitions: Furnish galvanized steel supports and leveling bolts at pilasters, as recommended by manufacturer to suit floor conditions. Make provisions for setting and securing continuous extruded aluminum anti-grip overhead-bracing at top of each pilaster. Furnish shoe at each pilaster to conceal supports and leveling mechanism.

Wall-Hung Screens: Furnish 24" wide x 42" high panel units of same construction and finish as partition system panels.

Hardware: Furnish hardware for each compartment to comply with ANSI A 117.1 and ADA Accessibility Guidelines for Buildings and Facilities for handicapped accessibility and as follows:

Hinges: Cutout inset type, adjustable to hold door open at any angle up to 90 degrees. Provide gravity type, spring-action cam type, or concealed torsion rod type, to suit manufacturer's standards.

Latch and Keeper: Manufacturer's standard surface-mounted latch unit, designed for handicapped accessibility emergency access, with combination rubber-faced door strike and keeper.

Coat Hook: Manufacturer's standard unit, combination hook and rubber-tipped bumper, sized to prevent door hitting mounted accessories.

Door Pull: Manufacturer's standard unit for out-swing doors. Provide pulls on both faces of handicapped compartment doors.

FINISHES

Baked Enamel Finish:

Clean galvanized steel surfaces after fabrication and before application of enamel coating system, to remove processing compounds, oils, and other contaminants.

Prime metal with baked-on rust inhibitive primer.

Apply two coats of thermostating enamel finish, applied by electrostatic process, and baked in accordance with paint manufacturer's instructions.

Colors: Combination of manufacturer's standard colors as selected by Contracting Officer.

PART 3 - EXECUTION

INSTALLATION

General: Comply with manufacturer's recommended procedures and installation sequence. Install compartment units rigid, straight, plumb, and level. Provide clearances of not more than 1/2" between pilasters and panels, and not more than 1" between panels and walls. Secure panels to walls with not less than two stirrup brackets attached near top and bottom of panel. Locate wall brackets so that holes for wall anchorages occur in tile joints. Secure panels to pilasters with not less than two stirrup brackets located to align with stirrup brackets at wall. Secure panels in position with manufacturer's recommended anchoring devices.

Overhead-Braced Compartments: Secure pilasters to floor and level, plumb, and tighten installation with devices furnished. Secure overhead-brace to each pilaster with not less than two fasteners. Hang doors and adjust so that tops of doors are parallel with overhead-brace when doors are in closed position.

Screens: Attach with anchoring devices as recommended by manufacturer to suit supporting structure. Set units to provide support and to resist lateral impact.

ADJUST AND CLEAN

Hardware's Adjustment: Adjust and lubricate hardware for proper operation. Set hinges on in-swinging

TOILET COMPARTMENTS

doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors (and entrance swing doors) to return to fully closed position.

Clean exposed surfaces of partition systems using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period.

END OF SECTION 10155

SECTION 10200 - LOUVERS AND VENTS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

Fixed metal wall louvers.

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

Division 7 Section "Manufactured Wall Panels" for wall and soffit panels.

Division 7 Section "Joint Sealants" for sealants installed in perimeter joints between louver frames and adjoining construction.

Division 9 Section "Painting" for field painting louvers.

Division 15 Sections for ductwork connected to metal wall louvers.

DEFINITIONS

Louver Terminology: Refer to Air Movement and Control Association (AMCA) 501 for definitions of terms for metal louvers not otherwise defined in this Section or in referenced standards.

PERFORMANCE REQUIREMENTS

Structural Performance: Engineer, fabricate, and install exterior metal wall louvers to withstand the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.

Wind Load: Uniform pressure (velocity pressure) of 30 psf., acting inwards or outwards.

Normal thermal movement is defined as that resulting from the following maximum change (range) in ambient temperature. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.

Temperature Change (Range): 100 deg F (56 deg C).

Air-Performance, Water-Penetration, and Air-Leakage Ratings: Provide louvers complying with performance requirements indicated as demonstrated by testing manufacturer's stock units of height and width indicated. Test units according to AMCA 500. Refer to Mechanical Schedule for performance requirements.

Perform testing on unpainted, cleaned, degreased units.

Perform water-penetration testing on louvers without screens.

SUBMITTALS

General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

Product data for each type of product specified.

Shop drawings of louver units and accessories. Include plans, elevations, sections, and details showing profiles, angles, and spacing of louver blades; unit dimensions related to wall openings and construction; free areas for each size indicated; profiles of frames at jambs, heads, and sills; and anchorage details and locations.

Samples for initial selection in the form of manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

Samples for verification of each type of metal finish required, prepared on samples of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

Product test reports evidencing compliance of units with performance requirements indicated.

Product certificates signed by louver manufacturers certifying that their products comply with the specified requirements and are licensed to bear the AMCA seal based on tests made according to AMCA 500 and complying with the AMCA Certified Ratings Program.

QUALITY ASSURANCE

Single-Source Responsibility: Obtain louvers and vents from one source and by a single manufacturer where alike in one or more respects regarding type, design, and factory-applied color finish.

Welding Standards: Comply with applicable provisions of D1.2 "Structural Welding Code--Aluminum," and D1.3 "Structural Welding Code--Sheet Steel."

Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

SMACNA Standard: Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

PROJECT CONDITIONS

Field Measurements: Check actual louver openings by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Louvers:

American Warming and Ventilating, Inc.
Construction Specialties, Inc.
Greenheck Fan Corp.
Louvers & Dampers, Inc.
Ruskin Mfg., Tomkins Industries, Inc.

MATERIALS

Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 or T-52.

Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer to produce required finish.

Fasteners: Of same basic metal and alloy as fastened metal or 300 series stainless steel, unless otherwise indicated. Do not use metals that are corrosive or incompatible with joined materials.

Use types and sizes to suit unit installation conditions.

Use Phillips flat-head screws for exposed fasteners, unless otherwise indicated.

Anchors and Inserts: Of type, size, and material required for type of loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 except containing no asbestos fibers.

FABRICATION, GENERAL

General: Fabricate louvers and vents to comply with requirements indicated for design, dimensions, materials, joinery, and performance.

Assemble louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances of louvers, adjoining construction, and perimeter sealant joints.

Provide frames with special shape at locations indicated.

Include supports, anchorages, and accessories required for complete assembly.

Provide vertical mullions of type and at spacings indicated but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

Provide sill extensions and loose sills made of same material as louvers where indicated or required for drainage to exterior and to prevent water penetrating to interior.

Join frame members to one another and to fixed louver blades as follows, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary:

With fillet welds, concealed from view; or mechanical fasteners; or a combination of these methods; as standard with louver manufacturer.

FIXED, EXTRUDED-ALUMINUM WALL LOUVERS

Horizontal, Double Drainable, Fixed-Blade Louvers: Extruded-aluminum frames and louver blades, designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and channels in jambs and mullions, complying with the following requirements:

Louver Depth: 4 inches, unless otherwise indicated.

Frame Thickness: 0.090 inch

Blade Thickness: 0.081 inch

Blade Angle: 45 degrees, unless otherwise indicated.

Performance Requirements: As follows, determined by testing units 48 inches wide by 48 inches high per AMCA 500:

Free Area: Not less than 7.00 sq. ft.

Static Pressure Loss: Not more than 0.17 inch wg at an airflow of 900 fpm free area intake velocity.

Water Penetration: Not more than 0.01 oz. per sq. ft. of free area at an airflow of 900 fpm free area velocity when tested for 15 minutes.

Refer to Mechanical Schedule for requirements.

AMCA Seal: Mark units with the AMCA Certified Ratings Seal.

LOUVER SCREENS

General: Provide each exterior louver with louver screens complying with the following requirements:

Screen Location for Fixed Louvers: Interior face, unless otherwise indicated.

Screening Type: Bird screening.

Secure screens to louver frames with stainless-steel machine screws, spaced 6 inches maximum from each corner and at 12 inches o.c. between.

Removable Louver Screen Frames: Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:

Metal: Same kind and form of metal as indicated for louver frames to which screens are attached.

Reinforce extruded-aluminum screen frames at corners with clips.

Finish: Same finish as louver frames to which louver screens are attached.

Louver Screening for Aluminum Louvers: Fit aluminum louver screen frames with screening covering louver openings and complying with the following requirements:

Bird Screening: 3/4-inch-by-0.050-inch-thick flattened, expanded aluminum.

FINISHES, GENERAL

Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

Finish louvers after assembly.

ALUMINUM FINISHES

Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.

Fluoropolymer 3-Coat Coating System: Manufacturer's standard 3-coat, thermocured system composed of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2.

Color and Gloss: As selected by Contracting Officer from manufacturer's full range of choices for color and gloss to match soffit panel.

PART 3 - EXECUTION

PREPARATION

Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

INSTALLATION

Locate and place louver units plumb, level, and at indicated alignment with adjacent work.

Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

Form closely fitted joints with exposed connections accurately located and secured.

Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

Repair finishes damaged by cutting, welding, soldering, and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items that cannot be refinished in the field to the shop, make required alterations, and refinish entire unit, or provide new units.

Protect galvanized- and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

Install flashings, joint fillers, and insulation, as louver installation progresses, where required to make

louver joints weathertight. Comply with Division 7 Section "Joint Sealants" for sealants applied during installation of louver.

ADJUSTING AND PROTECTION

Protect louvers from damage of any kind during construction period including use of temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at time of Substantial Completion.

Restore louvers damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by Contracting Officer, remove damaged units and replace with new units.

Clean and touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

CLEANING

Periodically clean exposed surfaces of louvers that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Rinse surfaces thoroughly and dry.

END OF SECTION 10200

SECTION 10265 - WALL SURFACE PROTECTION SYSTEMS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Division-1 Specification Sections, apply to this Section.

SUMMARY

This Section includes the following types of wall surface protection systems:

Wall protection systems, including:

Corner guards.

SUBMITTALS

General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

Product data for each wall surface protection system component and installation accessory required, including installation methods for each type of substrate.

Shop drawings showing locations, extent, and installation details of wall and corner guards, and other protection systems. Show methods of attachment to adjoining construction.

Samples for Verification Purposes: Submit the following samples, prepared from the same material to be used in the Work, for verification of color, pattern, and texture selected and for compliance with requirements indicated:

12-inch-long samples of each type of wall and corner guard required.

QUALITY ASSURANCE

Single Source Responsibility: Obtain each color, grade, finish, and type of wall surface protection system component from a single source with resources to provided products of consistent quality in appearance and physical properties without delaying progress of the Work.

DELIVERY, STORAGE, AND HANDLING

Deliver materials to Project site in original factory wrappings and containers, clearly labeled with identification of manufacturer, brand name, quality or grade, and fire hazard classification.

Store wall surface protection materials in original undamaged packages and containers inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

PART 2-PRODUCTS

MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

American Floor Products Co., Inc.
Balco, Inc.
Construction Specialties, Inc.
Pawling Corporation.
Wilkinson Company, Inc.

MATERIALS

Stainless Steel: AISI Type 304, stainless steel plate, minimum 16 gauge, No. 4 satin finish.

CORNER GUARDS

Stainless Steel Corner Guards: Provide manufacturer's standard paper-covered satin finish, 0.059-inch (16 gauge minimum, stainless steel sheet corner guards. Provide 90-degree turn, unless otherwise indicated, and formed edges.

Wing Size: 2-1/2" by 2-1/2" wings.

Height: As indicated on Drawings.

Mounting Method: Adhesive as recommended by manufacturer.

Corner Radius: 1/8 inch.

Exterior Corner Guards at Trash Enclosure: Equal to Durable Corporation, Model CG-2, abrasion-resistant natural SBR rubber, 4" x 4" x 7/8" thick at corner, length as indicated.

FABRICATION

General: Fabricate wall protection systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thicknesses of components.

Pre-assemble components in the shop to the greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free to evidence of wrinkling, chipping, uneven coloration, dents, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3-EXECUTION

EXAMINATION

Examine areas and conditions in which wall surface protection components and wall protection systems will be installed.

Complete all finishing operations, including painting, before beginning installation of wall surface protection system materials.

Do not proceed with installations until unsatisfactory conditions have been corrected.

PREPARATION

General: Prior to installation, clean substrate to remove dust, debris, and loose particles.

INSTALLATION

General: Install wall surface protection units plumb, level, and true to line without distortions. Comply with manufacturer's installation instructions.

Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished work.

CLEANING

General: Immediately upon completion of installation, clean plastic covers and accessories using a standard ammonia based household cleaning agent. Clean metal components in accordance with the manufacturer's recommendations.

END OF SECTION 10265

SECTION 10425 - SIGNS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following types of signs:

Panel signs.

Dimensional letters and numbers.

SUBMITTALS

General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.

Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

Provide message list for each sign required, including large-scale details of wording and layout of lettering.

For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed.

Furnish full-size spacing templates for individually mounted dimensional letters and numbers.

Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.

Samples for initial selection of color, pattern, and texture:

Cast Acrylic Sheet and Plastic Laminate: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.

Aluminum: Samples of each finish type and color, on 4-inch squares of sheet or plate, showing the full range of colors available.

Samples for verification of color, pattern, and texture selected, and compliance with requirements indicated:

Cast Acrylic Sheet and Plastic Laminate: Provide a sample panel not less than 8-1/2 inches by 11 inches for each material indicated. Include a panel for each color, texture, and pattern required. On each panel include a representative sample of the graphic image process required, showing graphic style, and colors and finishes of letters, numbers, and other graphic devices.

Aluminum: Samples of each finish type and color, on 4-inch squares of sheet or plate. Where finishes involve normal color and texture variations include sample sets showing the full range of variations expected.

QUALITY ASSURANCE

Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.

PROJECT CONDITIONS

Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 -PRODUCTS

MATERIALS

Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested in accordance with ASTM D 790, a minimum allowable continuous service temperature of 176°F (80°C), and of the following general types:

Transparent Sheet: Where sheet material is indicated as "clear," provide colorless sheet in matte finish, with light transmittance of 92 percent, when tested in accordance with the requirements of ASTM D 1003.

White Translucent Sheet: Where sheet material is indicated as "white," provide white translucent sheet of density required to produce uniform brightness and minimum halation effects.

Opaque Sheet: Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer's standards.

Aluminum Sheet: Provide aluminum sheet of alloy and temper recommended by the aluminum producer or finisher for the type of use and finish indicated, and with not less than the strength and durability properties specified in ASTM B 209 for 5005-H15.

ABS Plastic: Provide high-impact thermoplastic composed of copolymers of acrylonitrile, butadiene, and styrene.

Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

Colored Coatings for Acrylic Plastic Sheet: Use colored coatings, including inks and paints for copy and background colors, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are non-fading for the application intended.

PANEL SIGNS

Panel Signs for Exterior Room Identification: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.

Framed Panel Signs for Interior Room Identification: Fabricate frames to profile indicated; comply with the following requirements for materials and corner conditions:

Material: Manufacturer's standard.

Corner Condition: Corners rounded to radius indicated.

Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.

Raised Copy: Machine-cut copy characters from matte-finish opaque acrylic sheet and chemically weld onto the acrylic sheet forming sign panel face. Produce precisely formed characters with square cut edges free from burrs and cut marks.

Panel Material: Matte-finished opaque acrylic sheet.

Raised Copy Thickness: Not less than 1/32 inch.

Finish: Satin face, dark statuary matte edge.

Colors: As selected by Contracting Officer from full range of manufacturer's colors.

Pictograph Signage: Minimum 1/32" raised copy, symbol and braille. Braille shall be grade 2, flush with surface of sign.

Copy: As selected by Contracting Officer.

Sectional Signage: Minimum 1/32" raised copy and braille. Braille shall be grade 2, flush with surface of sign.

Copy: As selected by Contracting Officer.

Frames: Equal to JRS 640. Signs shall be held in frames with 1" magnetic stripping and steel plates.

Colors: As selected by Contracting Officer.

DIMENSIONAL LETTERS AND NUMBERS

Letters and Numbers: Form individual letters and numbers to produce characters with smooth, flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, or other defects. Comply with requirements indicated for finish, style, and size.

Letter Height: 48 inches.

Letter Style: Helvetica medium.

FINISHES

Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches as selected by the Architect from the manufacturer's standards.

Aluminum Finishes: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

Baked-Enamel Finish: AA-M4xC12C42R1x (Mechanical Finish: Manufacturer's standard, other nondirectional textured; Chemical Finish: Chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.

PART 3 - EXECUTION

SIGNS

9503
10425 - 4

INSTALLATION

General: Provide Room Identification Sign for each room at interior and exterior locations as indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.

Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

Wall Mounted Panel Signs: Attach panel signs to wall surfaces using methods recommended by the manufacturer.

CLEANING AND PROTECTION

At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage.

END OF SECTION 10425

SECTION 10505 - METAL LOCKERS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

Athletic lockers, including the following:

Single Tier: (12" wide x 18" deep x 72" high).

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

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

Division 6 Section "Rough Carpentry" for wood furring and grounds.

SUBMITTALS

General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

Product Data: Manufacturer's printed data including materials, accessories, construction, finishes, assembly, and installation instructions.

Shop Drawings: Layout and dimensions of metal lockers. Indicate relationship to adjoining surfaces. Show locker elevations and details, fillers, trim, base, sloping tops, and accessories. Include locker numbering sequence. Indicate installation and anchorage requirements.

Samples for Initial Color Selection: Manufacturer's color charts showing full range of available colors.

Maintenance Instructions: Instructions for cleaning lockers and for adjusting, repairing, and replacing locker doors and latching mechanisms.

QUALITY ASSURANCE

Single-Source Responsibility: Obtain locker units and accessories from one manufacturer.

DELIVERY, STORAGE, AND HANDLING

Do not deliver lockers until spaces to receive them are clean, dry, and ready for locker installation.

Protect lockers from damage during delivery, handling, storage, and installation.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide products by one of the following:

De Bourgh Manufacturing Co.

Republic Storage Systems Co., Inc.

MATERIALS

Steel Sheet: ASTM A 366 (A 366M), commercial-quality, stretcher-leveled, cold-rolled carbon steel sheet, stretcher leveled, free of buckling, scale, and surface imperfections.

Fasteners: Zinc- or nickel-plated steel; slotless-type exposed bolt heads; self-locking nuts or lock washers for nuts on moving parts.

Equipment: Manufacturer's standard plated steel hooks.

ATHLETIC LOCKERS

Body: Form tops and bottoms of 16 gage minimum steel sheet.

Form backs of 18 gage minimum steel sheet.

Form sides and intermediate partitions of 16 gage minimum steel sheet.

Frames: Form welded frames and cross frames of minimum 16 gage steel sheet channels or angles.

Door: Form door of steel sheet with flanged edges 14 gage minimum.

Reinforcing: Construct doors to prevent springing when opening or closing.

Hinges: Heavy-duty, full-loop, 5- or 7-knuckle, tight pin, 2 inches high minimum. Weld to inside of frame and secure to door with not less than 2 factory-installed fasteners that are completely concealed and tamperproof when door is closed.

Provide at least 3 hinges for each door 42 inches and higher and at least 2 hinges for each door less than 42 inches high.

METAL LOCKERS

Louvered Vents: Stamped louvered vents in door face per manufacturer's standard.

Latching: Manufacturer's standard lift handle.

Provide lock slip for locking with padlock at two-person lockers.

LOCKER ACCESSORIES

Equipment: Furnish each locker with the following items, unless otherwise shown:

Single Tier: One hat/bookshelf and 1 double-prong ceiling hook, and not fewer than 2 single-prong wall hooks.

Number Plates: Manufacturer's standard etched, embossed, or stamped, nonferrous-metal number plates with numerals not less than 3/8 inch high. Number lockers in sequence. Attach plates to each locker door, near top, centered, with at least 2 fasteners of same finish as number plate.

Recess Trim: Manufacturer's standard 18 gage minimum steel sheet trim with concealed fastening clips.

Filler Panels: 18 gage minimum steel sheet, factory fabricated.

Provide filler panels at ends and soffits as required.

Finished End Panels: Manufacturer's standard minimum steel sheet end-finishing panels to conceal exposed ends of non-recessed lockers.

FABRICATION

Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch. Weld frame members together to form a rigid, 1-piece structure.

Form locker body panels, doors, shelves and accessories from 1-piece steel sheet unless otherwise indicated.

Pre-assemble lockers by welding all joints, seams, and connections. Grind exposed welds flush.

FINISHES, GENERAL

Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plated surfaces.

Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering prior to shipment.

STEEL SHEET FINISHES

Surface Preparation: Solvent-clean surfaces complying with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel complying with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP 8 (Pickling), and phosphatize surfaces.

Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-enamel finish consisting of a thermosetting topcoat. Comply with paint manufacturer's instructions for application and baking to achieve a minimum dry film thickness of 1.1 mils on doors and frames and 0.7 mil elsewhere.

Color and Gloss: As selected by Contracting Officer from manufacturer's full range of choices for color and gloss.

PART 3 - EXECUTION

INSTALLATION

Install metal lockers complete with accessories according to manufacturer's recommendations. Install plumb, level, rigid, and flush.

Connect together welded locker groups with standard fasteners according to manufacturer's recommendations, with no exposed fasteners on face frames.

Anchor lockers to floors and walls at intervals recommended by manufacturer but no greater than 36 inches. Install anchors through back-up reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.

Install sloping top units to lockers using concealed fasteners. Provide hairline joints and concealed splice plates.

Install finished end panels to conceal exposed ends of non-recessed lockers.

ADJUSTING, CLEANING, AND PROTECTION

Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.

Clean interior and exposed exterior surfaces and polish stainless-steel and nonferrous metal surfaces.

Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit locker use during construction.

Touch up marred finishes, or replace locker units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10505

SECTION 10522 - FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

Fire extinguishers

Fire extinguisher cabinets.

Mounting brackets.

SUBMITTALS

Product data for each type of product specified. For fire extinguisher cabinets include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.

Samples for initial selection purposes in form of manufacturer's color charts showing full range of colors available for those units with factory-applied color finishes.

QUALITY ASSURANCE

Single-Source Responsibility: Obtain fire extinguishers and cabinets from one source from a single manufacturer.

Coordination: Verify that fire extinguisher cabinets are sized to accommodate fire extinguishers of type and capacity indicated.

UL-Listed Products: Fire extinguishers shall be UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products by one of the following:
J.L. Industries.

Larsen's Manufacturing Co.
Modern Metal Products by Muckle.

FIRE EXTINGUISHERS

General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Contracting Officer from manufacturer's standard, which comply with requirements of governing authorities.

Fill and service extinguishers to comply with requirements of governing authorities and manufacturer.

Multipurpose Dry Chemical Type: UL-rated 4-A:60-B:C, 10-pound nominal capacity, in enameled steel container.

MOUNTING BRACKETS

Provide brackets designed to prevent accidental dislodgement of extinguisher, of sizes required for type and capacity of extinguisher indicated, in plated finish.

Provide brackets for extinguishers not located in cabinets.

FIRE EXTINGUISHER CABINETS

General: Provide fire extinguisher cabinets, of suitable size for housing fire extinguishers of types and capacities indicated.

Construction: Manufacturer's standard enameled steel box, with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames.

Cabinet Type: Suitable for mounting conditions indicated, of the following types:

Semi-recessed: Cabinet box (tub) partially recessed in walls of shallow depth.

Trim Style: Fabricate trim in one piece with corners mitered, welded, and ground smooth.

Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

Rolled-Edge Trim with 2-1/2 inch backbend depth.

Trim Metal: Of same metal and finish as door.

Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.

Enameled Steel: Manufacturer's standard finish, hollow steel door construction with tubular stiles and rails.

Door Style: Manufacturer's standard design.

Duo-Panel: Acrylic, clear 1/4-inch thick, vertical.

Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide door pull, exposed or concealed and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

Identify fire extinguisher in cabinet with FIRE EXTINGUISHER lettering applied to door. Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location.

Application Process: Silk screen.

Identify bracket-mounted extinguishers with FIRE EXTINGUISHER in red letter decals applied to wall surface. Use letter size, style, and location as selected by Contracting Officer.

FINISHES FOR FIRE EXTINGUISHER CABINETS, GENERAL

Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

Protect mechanical finishes on exposed surfaces from damage by application of strippable, temporary protective covering prior to shipment.

STEEL FIRE EXTINGUISHER CABINET FINISHES

Surface Preparation: Solvent-clean surfaces in compliance with SSPS-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel in compliance with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP8 (Pickling).

Baked Enamel Finish: Immediately after cleaning and pretreatment, apply manufacturer's standard 2-coat baked enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's instructions for application and baking to achieve a minimum dry film thickness of 2.0 mils.

Color and Gloss: As selected by Contracting Officer from manufacturer's standard choices for color and gloss.

Paint the following:

Exterior and interior of cabinet.

PART 3 - EXECUTION

INSTALLATION

Follow manufacturer's printed instructions for installation.

Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.

Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.

Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

Where exact location of surface-mounted cabinets and bracket-mounted fire extinguishers is not indicated, locate as directed by Contracting Officer.

END OF SECTION 10522

SECTION 10620 - OPERABLE PARTITIONS

PART 1 - GENERAL

1.1 SCOPE

- A. All applicable requirements of the General Conditions and Special Provisions govern work under this Section.

1.2 DESCRIPTION

- A. Furnish and install top supported, manually operated multi-directional operable partitions as shown on Architectural drawings including track, hangrods, mounting brackets, all miscellaneous hardware and appurtenances and all work necessary to attach track to structural components.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's written instructions for installation, operation and maintenance.
- B. Shop drawings: Furnish shop drawings showing complete sections, details and dimensions. Shop drawings shall fully detail:
 - 1. Track and anchorage to overhead structure.
 - 2. Stack track assemblies with panels in pocket.
 - 3. Panel carriers, locations and operating details.
 - 4. Top and bottom mechanical seals with method of activation and location of operating mechanism.
 - 5. Vertical seals on panels and expandable jamb attached to last panel for final closure.
 - 6. Panel construction showing gauges and thicknesses of all materials.
 - 7. Method of locking lead panel in stack position to prevent unauthorized operation of partitions.
 - 8. Inset pass door construction.
- C. Care and maintenance manual for Government at completion of project.
- D. Certificate: STC rating for operable partition.

1.4 QUALITY ASSURANCE

- A. See attached (MFR List).

1.5 CODES AND STANDARDS

- A. ASTM American Society for Testing Materials
- B. UL Underwriters Laboratories

1.6 GUARANTEE

- A. Partitions and installation shall be guaranteed under normal usage for a period of one (1) year after substantial completion.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. This Contractor is responsible for all freight charges, receiving, unloading and moving of materials to site.
- B. Factory wrap all panels in heavy plastic prior to crating and hang panels with protective plastic wrap in place. Remove wrapping to complete installation
- C. Use all means necessary to protect the Work of this Section until acceptance by Contracting Officer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Type: Factory applied standard vinyl material clad, remote stacked, individual panel partition system, top supported, with mechanical top and bottom acoustical sound seals, manual operation.
- B. To assure a high and satisfactory quality, the bidder shall manufacture, under his control, all parts comprising the operable partition and shall maintain thorough test and inspection procedures to assure a uniform high quality of all raw material used as well as finished product.
- C. Partition System: STC Rating shall be minimum of 50 plus or minus 1 STC.

2.2. ACCEPTABLE MANUFACTURERS

- A. HUF COR
P.O. Box 591
Kennedy Rd.
Janesville, WI 53547
Phone: (800) 542-2371 ext. 214
Fax: (608) 630-8203
www.hufcor.com
- B. Foldoor by Holcomb & Hoke
1545 Van Buren Street
Indianapolis, IN 46203

Phone (317) 784-2448
Fax: (317) 781-9164
www.foldoor.com

- C. PANELFOLD
P.O. Box 680130
Miami, FL 33168
Phone: (305) 688-3501
Fax: (305) 688-0185
www.panelfold.com

2.3 OPERABLE INDIVIDUAL PANELS

A. Construction

1. System: Provide manually operated partition, custom fabricated. Provide single panel operable partitions with offset stack assembly as shown on drawings.
2. Track and Suspension System: Furnish approved manufacturer's standard aluminum or steel track. Aluminum track to be clear anodized, or steel track to have factory-applied baked enamel finish in color to be chosen by Contracting Officer. Track joints to be keyed to assure proper alignment. Furnish track with integral supports for adjoining plenum closure. Provide two (2) self-lubricating ball bearing carriers. Track or carriers requiring lubrication at time of installation or at any future time shall not be permitted. Tracks incorporating rub or guide rails, and puck or puck/wheel type carriers not permitted. Track weight shall not exceed 10 pounds per lineal foot.
3. Adjustable Track Hangers: Furnish track hanging brackets and threaded rods as required to attach track to overhead steel. Furnish sway bracing for track as required. No holes will be permitted to be field drilled in structural steel. Furnish template to steel contractor for required hole punching.
4. Panels: Partition shall consist of equal size panels, 3" thick and not to exceed 48.5" wide. Panel faces to be manufacturer's standard vinyl fabric factory laminated to 5/8" gypsum board backed with a 20 gauge steel acoustical liner. Panel faces shall be mounted in full perimeter metal frames to enclose and protect all edges of the surface material. Panels using wood frame construction either internally or externally not permitted. Panel faces shall be removable and replaceable on the job site. Panel weight shall not exceed 10 pounds per square foot because of structural limitations. Panels to be factory assembled in one piece. Field splicing of panel faces not permitted.
5. Stacking Dimensions: Per panel stacking depth shall not exceed panel thickness.
6. Seals: Provide top and bottom mechanical seals simultaneously operated by a removable handle concealed in the panel edge. The seals shall not contact the floor or the track during movement of the panels. Operation of the seals shall require no more than a 180 degree turn of the handle. Operating mechanism shall be located approximately 42" above finished floor. Floor seals shall provide for minimum 2" clearance and exert a minimum of 40 lbs. downward force when extended. Sweep strips, foot bolts, bump or trip-back seals

or activation of seals from panel face shall not be permitted. Mechanical seals shall allow panels to be locked into place anywhere along track runs independent of other panels.

7. Sound seals between panels shall be tongue and groove configuration incorporating aluminum astragals and vinyl acoustical seals.
8. Final closure to be by expandable lever closure panel. Panel consists of a basic panel equipped with an expanding jamb member and is operated from either face by a removable handle. Panels shall be capable of compensating for out-of-plumb condition or minor wall irregularities and provide a minimum of 250 lbs. of seal force against the adjacent wall for optimum sound control. The jamb activator shall be located approximately 45" from the floor in the panel face and be accessed from either side of the panel. Expanding jamb member to have approximately 5" of travel. Expanding jamb to be finished with vinyl to match panel faces.
9. Lead panels to have 1" vinyl bulb type compression seal.
10. No fixed wall jambs permitted.
11. Pass Door Panels: Provide inset pass doors where indicated on Drawings. Pass doors must comply with ADA requirements - providing 32" minimum clear opening with door in 90 degree position to panel run; doors shall have maximum five (5) pounds force for pushing or pulling open; handles, pulls or latches cannot require tight grasping, tight pinching or twisting of the wrist to operate. Hinges shall be 18 gauge steel and project no more than 1/4" beyond face of panel. There shall be a minimum of three hinges per door spaced to provide optimum support. Panel containing pass door shall be of the same construction and finish as the standard basic panels. No threshold permitted. Door latchset shall be recessed and shall not protrude beyond the face of panel. The entire pass door panels shall be self-sufficient and shall not depend on the adjacent panels for support.

Pass

door panels shall not affect the operation of partition mechanical seals. Provide one (1) recessed, self powered exit light per pass door opening.

2.3 PARTITION PLENUM CLOSURE

- A. Drywall Partition Contractor shall construct plenum closure from track to bottom of roof deck. Closure shall maintain sound rating of partition. Plenum closure shall be constructed so as to allow for access to track and hangers for future adjustment. Plenum closure shall have total of two (2) (one (1) each side) layers of 5/8" gypsum board on structural framing with sound insulation batts inside.

2.4 FINISHES

- A. Track: Aluminum track to have clear anodized finish. Steel track to have factory applied baked enamel finish.
- B. Panel Frames: Medium bronze or gray finish.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Installation shall be accomplished only by factory authorized installers with experience in operable partition installation.
- B. In strict accordance with the manufacturer's printed instructions.
- C. Verify opening is within tolerances before proceeding with the installation. If opening is not within tolerances, have defects corrected.

3.2 WORK BY OTHERS

- A. Overhead support for partitions and stack assemblies furnished and installed by others. All structural steel support shall be pre-drilled for track hanger rods to template supplied by partition contractor.
- B. Floor and overhead support shall be level within 1/4" in 10'-0", noncumulative, across the entire length of the partition. Jamb openings must be plumb.
 - 1. If the floor is not within these limits, the General Contractor shall grind smooth and/or fill to meet these requirements.
 - 2. If the jambs are out of plumb, General Contractor to correct as required.

3.3 CLEANING AND ADJUSTMENT

- A. Clean all surfaces.
- B. Adjust partition for smooth, free operation and latching.
- C. Manufacturer's representative shall demonstrate for Government proper operation and care of partitions.
- D. Turn over to Government two (2) operating handles of each type required for each partition.

END OF SECTION

SECTION 10800 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawing and general provisions of Contract, including General and Division 1 Specification Sections, apply to this section.

SUMMARY

This section includes toilet and bath accessory items as scheduled.

Toilet compartments and related accessories are specified in Section 10155.

SUBMITTALS

Product Data for each toilet accessory item specified, including details of construction relative to materials, dimensions, gages, profiles, method of mounting, specified options, and finishes.

Schedule indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.

Setting Drawings: Where cutouts are required in other work, provide templates, substrate preparation instructions, and directions for preparing cutouts and for installation of anchorage devices.

QUALITY ASSURANCE

Inserts and Anchorages: Furnish accessory manufacturers' standard inserts and anchoring devices that must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Contracting Officer.

PROJECT CONDITIONS

Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide toilet accessories by one of the following:

American Specialties, Inc.
Bobrick Washroom Equipment, Inc.
Bradley Corporation.
McKinney/Parker.

MATERIALS, GENERAL

Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22-gage (.034 inch) minimum thickness, unless otherwise indicated.

Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16, castings, ASTM B-30.

Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 20-gage (.040 inch) minimum, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.

Galvanized Steel Sheet: ASTM A 527, G60.

Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

Mirror Glass: Nominal 6.0 mm (0.23 inch) thick, conforming to ASTM C 1036, Type I, Class I, Quality q2, and with silvering, electro-plated copper coating, and protective organic coating.

Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.

FABRICATION

General: No names or labels are permitted on exposed faces of toilet and bath accessory units. On either interior surface not exposed to view or on back surface, provide identification of each accessory item by either a printed, waterproof label or a stamped nameplate indicating manufacturer's name and product model number.

Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all welded construction, without mitered corners. Hang doors or access panels with full-length stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.

Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, and re-supply. Provide minimum of six keys to Contracting Officer.

PART 3 - EXECUTION

INSTALLATION

Install toilet accessory units in accordance with manufacturer's instructions, using fasteners appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated.

ADJUSTING AND CLEANING

Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

Clean and polish all exposed surfaces in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.

TOILET ACCESSORY SCHEDULE

- A. Toilet tissue dispenser shall be equal to ASI, Model 0715, surface mounted double roll toilet tissue dispenser fabricated of heavy gage satin chrome plated steel.
- B. Recessed paper towel dispenser and waste receptacle equal to ASI, Model 0469.
- C. Mirror, Re: Specification Section 08800.
- D. All purpose Lav-basin soap dispenser equal to ASI, Model 0330.
- E. Shower curtain rod shall be equal to American Specialties, Inc., Model 1206, 1" diameter stainless steel tubing with satin finish. Provide rods complete with stainless steel flanges equal to ASI, Model 1209.
- F. Shower curtain shall be equal to American Specialties, Inc., Model 1200, 100% 8 ounce sanforized white duck, bleached and mildew resistant with rustproof chrome plated nylon reinforced grommets. Curtain shall be 12" wider than the opening. Provide curtain complete with chrome finish shower curtain hooks. Field verify curtain heights.
- G. Recessed ceramic tile soap dish. Refer to Spec. Section 09300.
- H. Double robe hook shall be equal to Bobrick Washroom Equipment, Inc. Model B-672, polished

stainless steel.

- I. Surface mounted napkin disposal shall be equal to ASI, Model 0852. Furnish with disposable wet-strength paper liner.
- J. Surface mounted vertical soap dispenser shall be equal to ASI, Model 0343, satin finish, with all purpose liquid soap valve and refill window.
- K. Surface mounted paper towel dispenser - petite shall be equal to ASI, Model 0215, satin finish stainless steel.

END OF SECTION 10800

SECTION 12511 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes basic window treatment as follows:

Provide horizontal blinds.

SUBMITTALS

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product data and installation instructions for each type of window treatment unit required. Include methods of installation for each kind of opening and supporting structure.

Shop drawings showing location and extent of blinds and for special components and application conditions that are not fully dimensioned or detailed in manufacturer's product data. Show relationships to adjoining work.

Maintenance data to include in Operating and Maintenance Manual specified in Division 1.

Samples for initial selection of colors, in form of manufacturer's color charts consisting of sections of exposed components with integral or applied finishes showing full range of colors and materials.

Samples for Verification Purposes: One 12-inch-long slat for each color slat selected.

QUALITY ASSURANCE

General: Provide units produced by one manufacturer for each type required, with complete standard assemblies including hardware accessory items, mounting brackets, and fastenings.

Installer Qualifications: Engage an experienced Installer who has specialized in installing blinds similar to those required for this Project.

Furnish materials in colors and patterns as selected by Contracting Officer from manufacturer's full range of colors and patterns.

PROJECT CONDITIONS

Field Measurements: Check openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the Work.

Coordinate wall and ceiling construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

PART 2 - PRODUCTS

HORIZONTAL BLINDS

Headrail: Channel-shaped section approximately 1" high x 1-1/2" wide complete with tilting mechanism, top and end braces, top cradles, cord lock, and accessory items required for type of blind and installation.

Bottom Rail: Tubular steel bottom rail, designed to withstand twisting or sagging. Contour top surface to match slat curvature, with flat or slightly curved bottom. Close ends with metal or plastic end caps of same color as rail. Finish rail in same color as slats.

Slats: Spring-tempered aluminum (louver blades), rounded corners with forming burrs removed, as follows:

Slat Width: 1-inch (25 mm) nominal slats, 0.008" nominal thickness, with other components sized to suit.

Ladders: Designed to support and maintain slats at proper spacing and alignment in open and closed positions, as follows:

Braided polyester cord design consisting of vertical components of not less than 0.043-inch nor more than 0.068-inch in diameter and integrally braided ladder rungs of not less than 4 threads; space ladders not further than 23 inches apart and 7 inches from ends of slats.

Tilting Mechanism: Assembly including disengaging worm and gear mechanism to eliminate overdrive, low-friction gear tilter, drum and cradle at each ladder, tilt rod, tape clips, and grommet guides to prevent wear on ladder and cords; designed to hold slats at any angle and prevent movement of slats due to vibration, operated as follows:

Wand Operator: Detachable clear plastic wand, of proper length to suit blind installation, detachable without tools by raising locking sleeve.

Lifting Mechanism: Crashproof cord locks with cord separators and braided polyester or nylon lift cords. Size cord to suit blind type. Include self-aligning cord equalizers designed to maintain horizontal blind position.

Installation Brackets: Designed to facilitate removal of head channels. Provide intermediate brackets at

spacing recommended by blind manufacturer. Include hardware necessary for secure attachment of brackets to adjoining construction and to headrails. Design brackets to support safely the weight of blind assemblies plus forces applied to operate blinds.

Finish: Provide finishes indicated below. Finish exposed accessories and hardware to match rail color. Provide corrosion-resistant finish to concealed items of hardware.

Steel Components: Galvanize and either phosphate coat or prime exposed steel surfaces. Finish with baked-on synthetic resin enamel finish.

Aluminum Slats: Chemical conversion coat followed with baked-on synthetic resin enamel finish coat.

Manufacturers: Subject to compliance with requirements, provide products of one of the following:

Bali Graber Contract, "Bali Classics Mini Blinds".

Hunter Douglas, Inc., "Contract Sunflex 1", Aluminum Blinds.

Architectural Products Div., Levelor Lorentzen, Inc., "Riviera 1" Blind.

FABRICATION AND OPERATION

Prior to fabrication, verify actual opening dimensions by accurate site measurements. Adjust dimensions for proper fit at openings.

Coordinate with other trades for securing tracks to substrates and other finished surfaces.

Fabricate window treatment components from non-corrosive, non-staining, non-fading materials that are completely compatible and do not require lubrication during normal expected life.

Fabricate blind units to fill openings from head to horizontal mullion and jamb to jamb.

Space slats to provide overlap for light exclusion when fully closed.

Equip horizontal blind units for the following operation:

Full-tilting operation with slats rotating approximately 180 degrees. Place tilt operating controls on left hand side of blind units unless otherwise directed.

Full-height raising, to minimum stacking dimension, with lifting cord locks for stopping blind at any point of ascending or descending travel. Place pull cords on right-hand side of blind units unless otherwise indicated.

PART 3 - EXECUTION

EXAMINATION

Examine openings where horizontal louver blinds will be installed prior to beginning installation. Verify that critical dimensions are correct and surface conditions acceptable.

Complete all finishing operations, including painting, before beginning installation.

Do not proceed with installation until unsatisfactory conditions have been corrected.

INSTALLATION

General: Install window treatment units to comply with manufacturer's instructions. Position units level, plumb, secure, and at proper height and location relative to adjoining window units and other related work. Securely anchor units with clips, brackets, and anchorages suited to type of substrate.

Provide clearance between sash and blinds to permit unencumbered operation of sash hardware.

CLEANING AND PROTECTION

After completing the installation, clean blind surfaces according to the manufacturer's instructions.

Protect installed units to ensure their being in operating condition, without damage, blemishes, or indication of use at substantial completion of project. Correct nonconforming damaged units. Replace units that cannot be field corrected.

END OF SECTION 12511

SECTION 12690 - FLOOR MATS AND FRAMES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Division 1 Specification Sections, apply to Work of this Section.

DESCRIPTION OF WORK

This Section includes:

Recessed Floor Mats:

Roll-Up, Linked-Tread-Type Floor Mats

Related Sections: The following sections contain requirements that relate to this section:

Division 3 sections for concrete work, including forming, placing, and finishing concrete floor slabs and grouting frames into recess.

SUBMITTALS

Product data for floor mat and frame specified, including manufacturer's specifications and installation instructions, details of construction relative to materials, dimensions of individual components, profiles, and finishes.

Samples for initial selection purposes in form of manufacturer's color charts consisting of actual sections of floor mat and frame materials, showing full range of colors, textures, finishes, and patterns available.

Samples for verification purposes in form of 12-inch-square assembled section of floor mat and frame members with selected tread surface showing each type of metal finish and color of exposed floor mat, frames, and accessories required. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

Maintenance data in form of manufacturer's printed instructions for cleaning and maintaining floor mats.

PROJECT CONDITIONS

Field Measurements: Check actual blocked-out openings in floors by accurate field measurements before fabrication of frames and mats. Coordinate fabrication schedule with construction progress to avoid delay of Work.

Where field measurements cannot be made without delaying the Work, guarantee opening

dimensions and proceed with fabrication without field measurements. Coordinate floor construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

QUALITY ASSURANCE

Single-Source Responsibility: Obtain floor mats and frames from one source from a single manufacturer.

SEQUENCING AND SCHEDULING

Provide oversized recesses in concrete work to receive frames. Defer frame installations until building enclosure is completed and related interior finish work is in progress.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products of the following:

Balco, Inc., Type FMA-R.
Construction Specialties, Inc., Model PM425RM "Pedimat".

MATERIALS

General: Provide colors, patterns, and profiles of materials, including metals and metal finishes, as indicated on drawings or by this specification or as selected by Contracting Officer from manufacturer's full range of colors, patterns, and profiles.

Recessed Mat Frames: Provide manufacturer's standard design, of size and style to fit floor mat type for permanent recessed installation in floor, complete with corner pins or reinforcing and installation anchorages.

Provide frames of extruded aluminum, ASTM B 221, alloy 6063-T5. Coat surface of frame that will contact cementitious material with zinc chromate paint or manufacturer's standard protective coating.

Aluminum Finish: Dark bronze anodized finish or as selected by the Contracting Officer.

Provide frame members in single lengths.

Roll-Up-Type Vinyl Tread Floor Mats: Provide manufacturer's standard vinyl-acrylic hinged tread-slat mat system, with slotted or perforated hinges to form 2 inch-wide by 3/8-inch-thick slat modules, with top-surface tread inserts and vinyl edge accessories to accommodate frame application as indicated. Provide type of tread inserts as specified below.

FLOOR MATS AND FRAMES

Tread Surface: Abrasive fill or insert of aluminum oxide or silicon carbide grit in epoxy matrix.

Color: As selected by Contracting Officer from manufacturer's full range of colors.

FABRICATION

Shop fabricate units of floor mat work to greatest extent possible in sizes as indicated. Where not otherwise indicated, provide single unit for each mat installation, but do not exceed manufacturer's maximum size recommendation for units intended for removal and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints. Where possible, verify sizes by field measurement before shop fabrication.

PART 3 - EXECUTION

INSTALLATION

Install recessed frames and mats to comply with manufacturer's instructions, at locations indicated and with top of frames and mats in proper relationship to one another and to adjoining finished flooring. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with doors that swing across mats to provide under door clearance.

Where frame is embedded in grout, provide necessary shims, spacers, and anchorages for proper location and secure attachment.

PROTECTION

Upon completion of frame installations and concrete work, provide temporary filler of plywood or fiberboard in recesses, and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and project is near time of Substantial Completion.

Defer installation of floor mats until near time of Substantial Completion for project.

END OF SECTION 12690

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SECTION 15010 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Division 1 Specification Sections, apply to this and the other sections of Division 15.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:

- Submittals.
 - Coordination drawings.
 - Record documents.
 - Maintenance manuals.
 - Rough-ins.
 - Mechanical installations.
 - Cutting and patching.

- B. Related Sections: The following sections contain requirements that relate to this section:

- 1. Division 15 Section "ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT," for factory-installed motors, controllers, accessories, and connections.
 - 2. Division 15 Section "BASIC MECHANICAL MATERIALS AND METHODS," for materials and methods common to the remainder of Division 15, plus general related specifications including:

- Access to mechanical installations.

- Excavation for mechanical installations within the building boundaries, and from building to utilities connections.

1.3 EXAMINATION OF SITE

- A. Visit the site, inspect the existing conditions and check the drawings and specifications so as to be fully informed of the requirements for completion of the work.
- B. Lack of such information shall not justify an extra to the contract price.

1.4 SCOPE

- A. The Mechanical Work shall include labor, materials, and equipment to install systems and place in proper working order, as shown on plans and hereinafter specified. The installation shall include all labor, materials, tools, transportation, equipment, services and facilities, required for the complete, proper and substantial installation of all mechanical work shown on the plans, and/or outlined in these specifications. The installation shall include all materials, appliances, and apparatus not specifically mentioned herein or noted on the drawings but which are necessary to make a complete working installation of all mechanical systems.
- B. By bidding, this contractor acknowledges his understanding of the work to be done and agrees to install complete and workable systems.

1.5 CODES

- A. Execute work in compliance with all applicable Federal, State and Municipal laws, codes, ordinances, and local customs regarding the trade to perform the work.
- B. Codes shall govern in case of any direct conflict between codes and plans and specifications; except when plans and specifications require higher standards than those required by code. Variance from the plan and specifications made to comply with code must be approved by the Architect and Base CEEE. If approved they shall be made with no increased cost to the Government.
- C. In addition, the following published Standards and Regulations shall be adhered to as applicable to the work involved.

Latest issue of the Local, State, and National Plumbing Codes
Latest issue of the ASHRAE Guide
Latest issue of the SMACNA Handbook
Applicable NFPA Pamphlets
Applicable ANSI Standards

American Society of Mechanical Engineers Boiler Code
American Society of Mechanical Engineers Unfired
Pressure Vessel Code
American Standards Association Code for Mechanical
Occupational Safety and Health Act
Current Editions of Uniform Building Code, Uniform Mechanical Code,
Uniform Plumbing Code
Latest issue of the State Air Pollution Control Regulations
Rules of the State Boiler Inspection Department
Americans with Disabilities Act of 1990

1.6 DEFINITIONS

- A. It shall be understood that the drawings and specifications complement one another and items specified shall also meet the criteria set forth on the drawings.
- B. Where any device or item is referred to in the singular sense (such as "the unit"), such reference applies to as many devices as are required to complete the installation as shown on the drawings.
- C. The term "work" shall mean all obligations imposed upon the Contractor by the Contract Documents.

1.7 ABBREVIATIONS

ADA	Americans with Disabilities Act of 1990
AGA	American Gas Association
AISI	American Iron and Steel Institute
AMCA	Air Moving and Conditioning Association, Inc.
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration & Air-Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BPVC	Boiler and Pressure Vessel Code of ASME
CISPI	Cast Iron Soil Pipe Institute
NFPA	National Fire Protection Association
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association, Inc.
UL	Underwriters' Laboratories, Inc.
ETL	ETL Testing Laboratories, Inc.
OSHA	Occupational Safety and Health Administration
NBI	National Boiler Inspection Code

1.8 PERMITS

- A. Obtain and pay for all licenses and permits, fees, inspection and certificates required for the execution of this work.
- B. Pay fees and charges for connection to outside services and use of property.
- C. Deliver permits and certificates to the Architect for transmittal to the Government.

1.9 RESPONSIBILITY

- A. This contractor will be held responsible for any and all damage to any part of the building or to the work of other contractors, as may be caused through his operation.
- B. The operation and maintenance of the Mechanical Plant during construction shall be the responsibility of this contractor until the acceptance of the building by the Government.
- C. The General Contractor shall pay for all fuel cost for operation of the plant.
- D. This Contractor shall make all provisions for entry of equipment, installed under this Contract, to the installed location. This Contractor shall provide openings in existing construction if necessary. This Contractor shall do all repair necessary to restore the building to the original condition. During the period of entry of equipment and removal of trash, no disruption of the Government's normal business shall occur.

1.10 WORKMANSHIP AND COORDINATION

- A. Make installation substantially as shown on the plans.
- B. Pipe and duct routing and equipment location shown on the drawings are schematic in nature. Make alterations in location of apparatus or piping as may be required to conform to building construction without extra charge.
- C. Equipment service clearances, per equipment manufacturers specifications, shall be maintained from general construction. No pipe or ductwork shall be installed within these clearances. No piping, coils, or ductwork shall be installed above electrical panels, starters or switchgear, or in elevator equipment rooms.

- D. Cooperate with other contractors in their installation of work.
- E. The duct work shall take precedence over all pipe work except where it is necessary to maintain an even grade on the piping.
- F. Use only experienced mechanics.

1.11 MATERIALS

- A. Material and equipment shall be new, of best quality and design and free from defects. A manufacturer's nameplate affixed in a conspicuous place will be required on each major component of equipment stating manufacturer's name, address and catalog number.

1.12 EXCAVATION AND BACKFILLING

- A. All work shall be in accordance with Section "EARTHWORK".
- B. Do all excavation required for water, gas, sewer, drainage, etc.
- C. Contractor shall do all shoring and bracing necessary per OSHA requirements to perform the work and as required for safety.
- D. Backfill and tamp the earth around pipes and bring to required level. Compact to percentage amount specified in Section "EARTHWORK"
- E. Fill carefully to prevent future settlement.
- F. Backfill trenches under concrete floor, drive, or walks, with sand, crushed rock, or gravel in manner to prevent future settlement. Backfilling of trenches shall be in conformance with requirements for earthwork in the Architectural Specifications.
- G. Street and alley pavement surfaces damaged must be repaired to the satisfaction of the local authorities.

1.13 TESTING

- A. Furnish testing equipment and test all piping systems under methods and conditions as specified.
- B. Test for a period of not less than 12 hours in the presence of the Architect.

- C. Make all necessary replacements and repair and repeat tests until the entire system is approved and satisfactory.
- D. Test under pressure with liquid or gas as directed or specified.

1.14 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Section "SUBMITTALS."
- B. Increase, by the quantity listed below, the number of mechanical related shop drawings, product data, and samples submitted, to allow for required distribution plus one copy of each submittal required, which will be retained by the Mechanical Consulting Engineer.

Shop Drawings - Initial Submittal: 1 additional blue- or black-line prints.

Shop Drawings - Final Submittal: 1 additional blue- or black-line prints.

Product Data: 1 additional copy of each item.

Samples: 1 additional set.

- C. Additional copies may be required by individual sections of these Specifications.
- D. Submittal of shop drawings, product data, and samples will be accepted only when signed and submitted by The Mechanical Contractor and the General Contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.
- E. Shop drawings submitted without contractor's signature or approval and verification will not be approved. Quantities will not be checked or verified. It is the contractors responsibility to provide the proper quantities required to complete the job.
- F. Portions of the work requiring a shop drawing submittal shall not begin until the shop drawing has been approved by the Engineer.
- G. Submit wiring diagrams for all mechanical equipment requiring field wiring clearly showing all required connections. This contractor will send one copy of Engineer approved shop drawings to the Electrical Contractor with a transmittal letter. Forward one copy of the transmittal letter to the Engineer's office.

- H. Where catalog cuts are used, mark them to indicate equipment, capacities, controls, fittings, valves, sizes, etc.
- I. Reference each item to applicable specification paragraph number and plan sheet number. Reference items not appearing in base specification to applicable alternate numbers, change order numbers, letters of authorization, etc.
- J. Engineers acceptance of Compliance Submittals will not relieve Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless Contractor has in writing called Engineer's attention to such deviation at the time of submission and Engineer has given written approval to the specific deviation, nor shall any acceptance by Engineer relieve Contractor from responsibility for errors or omissions in Compliance Submittals.

1.15 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Refer to the Instructions to Bidders and the Division 1 Section "SUBMITTALS" for requirements in selecting products and requesting substitutions.

1.16 PRODUCT LISTING

- A. Prepare listing of major mechanical equipment and materials for the project.
- B. Provide all information requested.
- C. Submit this listing as a part of the submittal requirement specified in the Division 1 Section.
- D. When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in Work, except as otherwise indicated.

Provide products which are compatible within systems and other connected items.

1.17 MECHANICAL COORDINATION DRAWINGS

- A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
1. Indicate the proposed locations of piping, ductwork, equipment, hangers, and materials. Include the following:
 - Clearances for installing and maintaining insulation.
 - Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
 - Equipment connections and support details.
 - Exterior wall and foundation penetrations.
 - Fire-rated wall and floor penetrations.
 - Underground piping.
 - Sizes and location of required concrete pads and bases.
 - Numbered valve location diagrams.
 - Valve stem movement.
 - Pipe expansion loops.
 - B. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 - C. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

- D. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.
- E. Submit a reproducible drawing to Architect to review for completeness. These drawings will be reviewed and returned with comments. They will not be approved as a shop drawing.

1.18 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1 Section "AS-BUILT DRAWINGS." These drawings shall reflect the actual "As-Built" condition including any change orders, of the mechanical systems and installation. In addition to the requirements specified in Division 1, indicate the following installed conditions:
 - 1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
 - 2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 15 Section "MECHANICAL IDENTIFICATION." Indicate actual inverts and horizontal locations of underground piping.
 - 3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - 4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 - 5. Contract Modifications, actual equipment and materials installed.

1.19 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1 Section "GUARANTEE." In addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

1.20 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

Adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
- C. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.
- D. All spiral duct stored at jobsite shall have ends of duct covered dust tight with plastic. All fans and coils stored in non enclosed areas shall be covered with plastic to prevent moisture dirt and debris from entering. All coils shall be protected from physical damage by plywood or masonite.
- E. All piping, valves, plumbing fixtures, motors and equipment stored in non-enclosed areas shall be covered with plastic to prevent moisture, dirt and debris from entering.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. The Contractor shall field verify all existing conditions and dimensions. The Contractor shall make field adjustments as required to accommodate the new work.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.2 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate mechanical systems, equipment, and materials installation with other building components, including the structure, fire sprinklers, and the electrical lights and equipment.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 - 4. 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.
 - 5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "ACCESS DOORS" and Division 15 Section "BASIC MECHANICAL MATERIALS AND METHODS."
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope, or systems requiring a fixed access clearance.
13. The Mechanical Contractor shall locate and mark the location of all holes and openings which require blocking out, cutting or core drilling.
14. Contractor shall review with Owner location, accessibility, and method of operating all domestic water and HVAC shut-off valves located in plumbing chases, ceiling cavity and mechanical rooms.
15. This contractor shall assist with and provide supervised start-up of the, hot water and chilled water systems, involving air venting, drainage, etc. Monitor the air venting until all air has been eliminated from the building system and the lines within the buildings are completely filled with fluid.
16. The ceiling cavity space is limited. Therefore the ductwork and piping locations shall be closely coordinated with each other as well as the lights, ceiling height, electrical conduit and fire sprinkler piping.
17. It is the intent, where possible to locate the domestic water piping, gas piping, fire sprinkler piping, and HVAC piping above the ductwork and tight to the structure.

18. Selected pipe and duct elevations are shown on the plans as an aid to the contractor in their installation. Where necessary, due to conflicts, these items may be changed as long as conflict with other items does not occur.
19. Ductwork and piping shall rise into the joist or beam space and run between joists or beams where shown on the drawings and as may be required, whether specifically shown or not, to avoid conflict with other trades.
20. This contractor shall be responsible for coordination with the fire sprinkler subcontractor and the Electrical Contractor as required to avoid and or resolve conflicts. Conflicts between piping, ducts, electrical, sprinklers, etc. shall be resolved with no additional cost or change to the contract amount.

3.3 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1 Section "CUTTING AND REPAIRING." In addition to the requirements specified in Division 1, the following requirements apply:
 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 1. Uncover Work to provide for installation of ill-timed Work.
 2. Remove and replace defective Work.
 3. Remove and replace Work not conforming to requirements of the Contract Documents.
 4. Remove samples of installed Work as specified for testing.
 5. Install equipment and materials in existing structures.
 6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

3.4 WARRANTIES

- A. Refer to the Division 1 Section: GUARANTEE for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

- B. Compile and assemble the warranties specified in Division 15, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- C. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.
- D. This Contractor shall warrant all material and equipment installed by him for a period of 1 year after completion of the project.

3.5 CLEANING

- A. Refer to the Division 1 Section: "SITE CLEAN-UP" for general requirements for final cleaning.
- B. Refer to Division 15 Section: "TESTING, ADJUSTING, AND BALANCING" for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.
- C. Contractor shall clean work area of all construction dirt and debris at the end of each work day.

END OF SECTION 15010

SECTION 15030 - ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Related Sections: Separate electrical components and materials required for field installation and electrical connections are specified in Division 16.

1.2 SUMMARY

- A. This section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory installed motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.

1.3 REFERENCES

- A. NEMA Standards MG 1: Motors and Generators
- B. NEMA Standard ICS 2: Industrial Control Devices, Controllers, and Assemblies.
- C. NEMA Standard 250: Enclosures for Electrical Equipment
- D. NEMA Standard KS 1: Enclosed Switches
- E. Comply with National Electrical Code (NFPA 70).

1.4 SUBMITTALS:

- A. No separate submittal is required. Submit product data including wiring diagrams, for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

1.5 QUALITY ASSURANCE

- A. Electrical components and materials shall be UL labeled.

PART 2 - PRODUCTS

2.1 MOTORS

- A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.
 1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
 2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
 3. 2-speed motors shall have 2 separate windings on poly-phase motors.
 4. Temperature Rating: Rated for 40 deg. C environment with maximum 50 deg. C temperature rise for continuous duty at full load (Class A Insulation).
 5. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly time spaced starts per hour for manually controlled motors.
 6. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
 7. Motor construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.

Bearings: ball or roller bearings with inner and outer shaft seals; re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance; designed to resist thrust

loading where belt drives or other drives produce lateral or axial thrust in motor; for fractional horsepower, light duty motors, sleeve type bearings are permitted.

8. Enclosure Type: open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation; guarded drip-proof motors where exposed to contact by employees or building occupants; weather protected Type I for outdoor use, Type II where not housed.
9. Overload protection: built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
10. Noise rating: "Quiet"
11. Efficiency: All new motors shall be "Energy Efficient" motors and shall have a minimum efficiency as listed below. If efficiency is not specified, motors shall have a higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112, test method B.

Nominal efficiency shall be 85% or better for motors 1 horsepower and larger. Nominal power factor shall be 74 or better for 1, 1 1/2, and 2 HP motors and 85 or better for 3 HP and larger.

12. Nameplate: indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

Motors used on system voltages 120/60/1 and 480/60/3 shall bear nameplate of 115/60/1 and 230/460/60/3 respectively.

2.2 STARTERS, ELECTRICAL DEVICES, AND WIRING

- A. All motor starters shall be provided by the Electrical Contractor, except where noted otherwise on the drawings to be provided with the Mechanical Equipment. Refer to the Electrical Specifications for motor starter requirements.
- B. Built-in 120 volts control circuit transformer, fused from line side, where service exceeds 240 volts.
- C. Externally operated manual reset.
- D. Under-voltage release or protection.

2.3 MOTOR CONNECTIONS

- A. Flexible conduit, except where plug-in electrical cords are specifically indicated.

2.4 DISCONNECT SWITCHES

- A. Disconnect Switches shall be provided by Electrical Contractor unless specifically called out on plans to be provided by the Mechanical Contractor.
- B. Fusible switches: fused, each phase; heavy duty; horsepower rated; non-teasible quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "OPEN" position; arc quenchers; capacity and characteristics as indicated.
- C. Non-fusible switches: for equipment 1 horsepower and smaller, shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as indicated. For equipment larger than 1 horsepower, switches shall be the same as fusible type.

2.5 POWER FACTOR CORRECTION

- A. Each motor (10 Horsepower and larger) except for motors with variable frequency drives, supplied for use within this project shall be supplied with capacitors as required to correct the power - factor of the individual motor to 95% (lagging) \pm 3%. The Mechanical Contractor shall secure performance data on each individual motor and condenser. Provide operating current values on the condenser, and on the motor, and total line current for the combination. Provide voltage reading at time of disconnecting motor.
- B. In no event shall the condenser current exceed the "no-load" values of the motor current. Heating element ratings shall be adjusted if, and as necessary, to provide thermal protection to the motor. In the event the voltage reading at the time of disconnecting the unit exceeds a safe value, the capacitor rating shall be changed to provide safe voltages, as well as providing a power factor within the specified limit. All condensers shall be rated for operation on the system voltage specified and furnished by the equipment manufacturer.
- C. Each capacitor shall be suitable for energizing at temperatures as low as -10· F. and for continuous operation in ambient temperatures not exceeding 115· F. when installed and unrestricted ventilation and energized up to 100 percent of rated voltage.

- D. Power factor correction capacitors shall be of the unit cell type. Individual capacitor cells shall be factory assembled and wired in a metallic, moisture-resistant enclosure. All power factor correction capacitors shall be UL listed. Capacitors shall be switched on and off with the motor and shall be installed and wired by the Electrical Contractor.
- E. Individual capacitor cells shall utilize polypropylene film as the dielectric with vacuum deposited aluminum layers as the electrodes. Each capacitor cell shall be furnished with replaceable fuses with a current limiting interrupting capacity of 100,000 Amps and filled with a completely biodegradable fluid.
- F. Discharge resistors shall be provided to reduce the residual voltage to 50 volts or less within one minute after the capacitor has been removed from the line. Resistors shall be mounted external to the capacitor cells to minimize the dielectric operating temperature.
- G. Enclosures shall be fabricated from sheet metal having a minimum thickness of 0.026", suitable for indoor or outdoor installations, designed to prevent accidental contact with live conducting parts, finished with a gray enamel and provided with integral mounting brackets for wall or floor mounting.
- H. Nameplate shall contain name of manufacturer, rated voltage, frequency, kilovar rating, number of poles and amount of combustible fluid in gallons. Nameplate shall be externally attached to the enclosure.

PART 3 - EXECUTION (Not Applicable).

END OF SECTION 15030

SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Division 1 Specification Sections, apply to this Section.
- B. Requirements specified in Division 15 Section "BASIC MECHANICAL REQUIREMENTS" apply to this Section.

1.2 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with mechanical installations as follows:
 - 1. Mechanical equipment nameplate data.
 - 2. Excavation for underground utilities and services, including underground piping (under the building and from building to utility connection), tanks, basins, and equipment.
 - 3. Miscellaneous metals for support of mechanical materials and equipment.
 - 4. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.
 - 5. Joint sealers for sealing around mechanical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
 - 6. Access panels and doors in walls, ceilings, and floors for access to mechanical materials and equipment.
 - 7. V-Belt drives.

1.3 DEFINITIONS

- A. The following definitions apply to excavation operations:

1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached.
2. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
3. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
4. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for the following products:
 - Access panels and doors.
 - Joint sealers.
- C. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for mechanical materials and equipment.
- D. Coordination drawings for access panel and door locations in accordance with Division 15 Section "BASIC MECHANICAL REQUIREMENTS."
- E. Samples of joint sealer, consisting of strips of actual products showing full range of colors available for each product.
- F. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.
- G. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.

1. Coordinate sequencing with construction phasing and Government occupancy requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer for the installation and application joint sealers, access panels, and doors.
- B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.
- C. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
 1. Provide UL Label on each fire-rated access door.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and damage.

1.7 PROJECT CONDITIONS

- A. Conditions Affecting Excavations: The following project conditions apply:
 1. Maintain and protect existing building services which transit the area affected by selective demolition.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.

3. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Government will not be responsible for interpretations or conclusions drawn from this information.
 4. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
 5. Uncharted or Incorrectly Charted Utilities: Contact utility owner immediately for instructions.
 6. Use of explosives is not permitted.
- B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS

2.1 MECHANICAL EQUIPMENT NAMEPLATE DATA

- A. Nameplate: For each piece of power operated mechanical equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Nameplates shall be stamped, permanent type only.

2.2 SOIL MATERIALS

- A. Comply with Section "EARTHWORK".

2.3 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, Grade B welded.

- E. Non-shrink, Non-metallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, nongaseous grout, recommended for interior and exterior applications.
- F. Fasteners: Zinc-coated, type, grade, and class as required.

2.4 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

2.5 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Elastomeric Joint Sealers: Provide the following types:
 - 1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
 - 2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
 - 3. Products: Subject to compliance with requirements, provide one of the following:

One-Part, Nonacid-Curing, Silicone Sealant:

"Chem-Calk N-Cure 2000," Bostic Construction Products Div.

"Dow Corning 790," Dow Corning Corp.

"Silglaze N SCS 2501," General Electric Co.

"Silpruf SCS 2000," General Electric Co.

"864," Pecora Corp.

"Rhodorsil 5C," Rhone-Poulenc, Inc.

"Spectrum 1," Tremco, Inc.

"Spectrum 2," Tremco, Inc.

"Dow Corning 795," Dow Corning Corp.

"Rhodorsil 6B," Rhone-Poulenc, Inc.

"Rhodorsil 70," Rhone-Poulenc, Inc.

"Omniseal," Sonneborn Building Products Div.

"Chem-Calk 100," Bostik Construction Products Div.

"Gesil N SCS 2600," General Electric Co.

One-Part, Mildew-Resistant, Silicone Sealant:

"Dow Corning 786," Dow Corning Corp.

"SCS 1702 Sanitary," General Electric Co.

"863 #345 White," Pecora Corp.

"Rhodorsil 6B White," Rhone-Poulenc, Inc.

"Proglaze White," Tremco Corp.

"OmniPlus," Sonneborn Building Products Div.

- D. Acrylic-Emulsion Sealants: One-part, non-sag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.

1. Products: Subject to compliance with requirements, provide one of the following:

"Chem-Calk 600," Bostik Construction Products Div.

"AC-20," Pecora Corp.

"Sonolac," Sonneborn Building Products Div.

"Tremco Acrylic Latex 834," Tremco, Inc.

E. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

"3M" Fire Stop Systems, St. Paul, Minn.
"Dow Corning Fire Stop Foam," Dow Corning Corp.
"Pensil 851," General Electric Co.

F. Pick-proof Sealant: All interior joints in areas of inmate accessibility.

1. Sealant shall meet or exceed requirements of ASTM C-920, Type M, Grade NS, Class 12-1/2; use T, M.

2. Sealant shall be 2 part and job site mixed.

3. Products: Subject to compliance with requirements, provide one of the following:

"HPL Sealant", Tremco, Inc.
"Dynflex". Pecora Corp.
"Sikadur 32, Hi-Mod" Sika
Peterson Corp.

2.6 ACCESS DOORS

A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

B. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.

1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.

2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
 3. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- C. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
- D. Locking Devices: Where indicated, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.
- E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- Bar-Co., Inc.
 - J.L. Industries.
 - Karp Associates, Inc.
 - Milcor Div. Inryco, Inc.
 - Nystrom, Inc.

2.7 V-BELT DRIVES

- A. Capacity of V-Belt Drives at rated RPM shall be not less than 150 percent of motor nameplate horsepower rating.
- B. V-Belt Drive combinations shall be limited to A, B, C, and fractional horsepower belts. 3V, 5V, and 8V belts and sheaves shall not be used.
- C. Drives requiring single belt application shall be of the adjustable pitch type. Multiple belt drives shall be of the non-adjustable type. All fixed pitch sheaves, including single groove fan sheaves, shall be of the bushed type. Fixed bore sheaves will not be acceptable for non-adjustable pitch sheaves.

2.8 DRIP PANS

- A. Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top, either by structural angles or by rolling top over 1/4" steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" drain line connections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION FOR JOINT SEALERS

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.3 EXCAVATION AND BACKFILL

- A. Perform excavation and backfill for mechanical work in accordance with DIVISION 2 SECTION "EARTHWORK".
- B. Provide backfill for underground tanks in accordance with the manufacturers requirements for material type, grade and compaction.
- C. Rock may be present on this site, and may be encountered during excavation. Refer to soils boring locations shown on civil plans, the soils boring logs, and Section 2 of the Specifications. Copies of the soil boring logs are available for review at the following:

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.6 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 - 2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
- C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around mechanical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.7 INSTALLATION OF ACCESS DOORS

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

3.8 INSTALLATION OF DRIP PANS

- A. Locate drip pans under piping passing within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

END OF SECTION 15050

SECTION 15055 - BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY:

- A. This Section specifies piping materials and installation methods common to more than one section of Division 15 and includes joining materials, piping specialties, and basic piping installation instructions.
- B. Related Sections:
 - 1. Division 15 BASIC MECHANICAL REQUIREMENTS section applies to the work at this Section.
 - 2. Piping materials and installation methods peculiar to individual systems are specified within their respective system specification sections of Divisions 2 and 15.
 - 3. Valves are specified in a separate section and in individual piping system sections of Division 15.
 - 4. Expansion Compensation is specified in a separate section of Division 15.
 - 5. Supports and Anchors are specified in a separate section of Division 15.
 - 6. Mechanical Identification is specified in a separate section of Division 15.
- C. Piping Systems - General
 - 1. Pipe for piping systems shall be cut accurately to measurements taken on the job.

2. Install offset connections for alignment of vertical to horizontal piping wherever required to make a true connection.
3. Make branch connections with offsets to provide for movement with the expansion of the piping system.
4. Install horizontal piping parallel to the building walls and partitions.
5. Do not run piping through elevator equipment rooms, transformer vaults or other electrical equipment spaces.
6. Valves, strainers, control valves, check valves and fittings shall be full size of the line they serve. Make change in pipe size noted on plans after last fitting on larger pipe. When supply pipes are larger than equipment tapings, reduce pipe size immediately prior to entry.

1.3 SUBMITTALS:

A. Refer to Division 1 and BASIC MECHANICAL REQUIREMENTS for administrative and procedural requirements for submittals.

B. Product Data: Submit product data on the following items:

- Escutcheons
- Dielectric Unions and Fittings
- Mechanical Sleeve Seals
- Strainers
- Piping
- Fire Barrier Penetration Seals

1.4 QUALITY ASSURANCE:

A. Welders Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing.

B. Welding procedures and testing shall comply with ANSI Standard B31.1.0 - Standard Code for Pressure Piping, Power Piping, and The American Welding Society, Welding Handbook.

C. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Mechanical Refrigeration.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Manufacturer uniformity: conform with the requirements specified in Basic Mechanical Requirements, under "Product Options."
- B. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:
 - 1. Pipe Escutcheons:
 - Chicago Specialty Mfg. Co.
 - Sanitary-Dash Mfg. Co.
 - Grinnell
 - 2. Dielectric Waterway Fittings:
 - Epcos Sales, Inc.
 - Victaulic Company of America
 - 3. Dielectric Unions:
 - Eclipse, Inc.
 - Perfection Corp.
 - Watts Regulator Co.

4. Strainers:

Armstrong Machine Works.
Hoffman Specialty ITT; Fluid Handling Div.
Metraflex Co.
Spirax Sarco.
Trane Co.
Victaulic Co. of America. (low pressure applications only)
Watts Regulator Co.

5. Mechanical Sleeve Seals:

Calpico Inc.
Thunderline Corp. (Link Seal)

2.2 PIPE AND FITTINGS:

- A. Refer to the individual piping system specification sections in Division 15 for specifications on piping and fittings relative to that particular system.
- B. All pipe and fittings shall be domestic manufactured. Foreign manufactured pipe will not be accepted. Each piece of pipe must be clearly labeled or stenciled with manufacturers name, type of pipe and length, in accordance with ASTM standards. All pipe must be new. Re-processed pipe which has been cleaned and re-finished due to extended yard storage will not be accepted. All pipe must be corrosion free. Submit shop drawings on piping along with certified mill specifications. If required by Engineer, the Contractor shall submit job site pipe samples, selected by Engineer, to the pipe manufacturer for verification of type and manufacturer. Any pipe not conforming to these specifications or not certified by manufacturers testing of samples, will be removed and replaced at contractor's expense.
- C. Steel Pipe Manufacturers: Newport, Bethlehem Steel Corp., Laclede Steel Co., United States Steel Co., Sawhill, Wheatland, Maverick, or Quanex Belleville Tube.
- D. Ferrous Fittings Manufacturers: Walworth, ITT Grinnell, Stockham or Crane.

NOTE: Weld-O-Lets and Thread O-Lets may be used when branch line diameter does not exceed 1/3 of the diameter on the main.

- E. Copper Pipe and Fitting Manufacturers: Mueller, Revere, Chase, Copperweld Tubing or Wheatland Tube.

2.3 JOINING MATERIALS:

- A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.
- C. Soldering Materials: Refer to individual piping system specifications for solder appropriate for each respective system. Do not use lead solder on water lines. Use 95-5 solder on water lines.
- D. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.4 PIPING SPECIALTIES:

- A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
- B. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
- C. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.
- D. Dielectric Waterway Fittings: electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
- E. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 3/64" perforations at 233 per square inch.

1. Provide strainers with 125 psi working pressure rating for low pressure applications (15 PSI or less), and 250 psi pressure rating for high pressure application (Above 15 PSI).
2. Threaded Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
3. Threaded Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
4. Flanged Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
5. Butt Welded Ends, 2-1/2" and Larger For Low Pressure Application: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.
6. Grooved Ends, 2-1/2" and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.

F. Sleeves:

1. Sheet-Metal Sleeves: 10 gage, galvanized sheet metal, round tube closed with welded longitudinal joint.
2. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.

G. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation. Provide compatible wall sleeve with proper inside diameter to accept the rubber links and with a water stop.

2.5 FIRE BARRIER PENETRATION SEALS

A. Manufacturer: Subject to compliance with requirements, provide fire barrier through penetration protection systems of one of the following:

Electro Products Div./3M
Nelson; Unit of General Signal
Bio Fire Shield, Inc.
Hilti

- B. Provide protection systems for any opening through fire-rated walls, floors, roof, or ceilings used as passage for mechanical components such as piping or ductwork. The sealer shall have a T-rating of 4 hours at penetrations in the 4 hour fire separations.

Cracks, Voids or Holes Up to 4" Diameter: Use putty or calking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL-listed.

Openings 4" or Greater: Use sealing system capable of passing 3-hour (or 4 hours where required) fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350 deg F (121 to 177 deg C), UL-listed.

- C. Execution: Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from both inside and outside of piping and fittings before assembly.

3.2 INSTALLATIONS:

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals. Coordinate locations of piping with ductwork, lights and other equipment.
- B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.
- C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

- D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- E. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- H. Install manual air vents at high points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- I. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves shall be steel; with water stop.
- J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained.
- K. Install Schedule 40 black steel pipe with welded fittings for emergency generator exhaust pipe. Install muffler and connect exhaust pipe as shown on plans.

3.3 FITTINGS AND SPECIALTIES:

- A. Use fittings for all changes in direction and all branch connections.
- B. Remake leaking joints using new materials.
- C. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.
- D. Install unions adjacent to each valve, and at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.
- E. Install Flanges in piping 2-1/2" and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.

- F. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum).
- G. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

3.4 JOINTS:

A. Steel Pipe Joints:

1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.

2. Pipe Larger Than 2":

Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.

Weld pipe joints of exterior water service pipe in accordance with AWWA C206.

Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.1.0 Code for Pressure Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

B. Non-ferrous Pipe Joints:

1. Brazed And Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.1.0 - Standard Code for Pressure Piping, Power Piping and ANSI B9.1 - Standard Safety Code for Mechanical Refrigeration.

Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.

2. Mechanical Joints: Flared compression fittings may be used for refrigerant lines 3/4" and smaller.

C. Other Pipe Joints:

1. Joints for other piping materials are specified within the respective piping system sections.

3.5 EXISTING BUILDING

- A. Existing HVAC, plumbing, or fire lines not to be used in the completed building shall be discontinued and capped in nearest wall, floor or ceiling so they are completely concealed.
- B. Existing piping, fixtures and equipment that are not to be reused shall be removed and shall remain the property of the Government if he wishes to retain ownership of same. If not, equipment shall become the property of this contractor and shall be removed from the site as soon as practical.
- C. When existing piping that are to be utilized in the completed program conflict with construction, they shall be relocated and reconnected to maintain the desired services.
- D. This Contractor shall give full cooperation to the General Contractor in scheduling and procedure of work.
- E. Existing piping and services that are in use by the Government shall not be interrupted without the approval of the Government. The existing building is a 24-hour occupied facility and therefore, it may be necessary to accomplish some work on holidays, weekends, and after regular work-day hours. Due to continuous operation of existing systems, some of the work will have to be phased to accommodate the Government's schedule. No extra costs shall be allowed for these existing conditions and constraints.
- F. All cutting and channeling of existing building shall be accomplished in a neat and workmanlike manner without removal of existing materials. This contractor shall patch and replace with material similar to adjacent construction.

3.6 FIELD QUALITY CONTROL

- A. Testing: Refer to individual piping system specification sections and Section 15990; "TESTING, ADJUSTING AND BALANCING".

END OF SECTION 15055

SECTION 15100 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division 1 Specification sections, apply to work of this section.
- B. The requirements of Division-15 Section "BASIC MECHANICAL REQUIREMENTS" apply to this Section.

1.2 SUMMARY:

- A. This Section includes general duty valves common to most mechanical piping systems.
- B. Special purpose valves are specified in individual piping system specifications.
- C. Valves tags and charts are specified in Division-15 Section "MECHANICAL IDENTIFICATION."

1.3 SUBMITTALS:

- A. Product Data: including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

1.4 QUALITY ASSURANCE:

- A. Single Source Responsibility: Comply with the requirements specified in Division-15 Section "BASIC MECHANICAL REQUIREMENTS," under "Product Options." All valves of the same type shall be of the same manufacturer whenever possible.
- B. MSS Standard Practices: Comply with the following standards for valves:

MSS SP-45: Bypass and Drain Connection Standard

MSS SP-67: Butterfly Valves

- MSS SP-70: Cast Iron Gate Valves, Flanged and Threaded Ends
- MSS SP-71: Cast Iron Swing Check Valves, Flanged and Threaded Ends
- MSS SP-72: Ball Valves with Flanged or Butt-Welding Ends For General Service
- MSS SP-78: Cast Iron Plug Valves, Flanged and Threaded Ends
- MSS SP-80: Bronze Gate, Globe Angle and Check Valves
- MSS SP-84: Steel Valves - Socket Welding and Threaded Ends
- MSS SP-85: Cast Iron Globe and Angle Valves, Flanged and Threaded Ends
- MSS SP-92: MSS Valve User Guide

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Preparation For Transport: Prepare valves for shipping as follows:

1. Ensure valves are dry and internally protected against rusting and galvanic corrosion.
2. Protect valve ends against mechanical damage to threads, flange faces, and weld end preps.
3. Set valves in best position for handling. Globe, and gate valves shall be closed to prevent rattling; ball and plug valves shall be open to minimize exposure of functional surfaces; butterfly valves shall be shipped closed or slightly open; and swing check valves shall be blocked in either closed or open position.

B. Storage: Use the following precautions during storage:

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

2. Protect valves against weather. Where practical store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement and protect in watertight enclosures.
- C. Handling: Valves whose size requires handling by crane or lift shall be slung or rigged to avoid damage to exposed valve parts. Handwheels and stems, in particular, shall not be used as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide valves from one of the manufacturers listed.

2.2 VALVE FEATURES:

- A. General: Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.
- B. Valve Design: Valves shall have rising stem, or rising outside screw and yoke stems; except, non-rising stem valves may be used where headroom prevents full extension of rising stems.
- C. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.
- D. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
- E. Operators: Provide the following special operator features:
 1. Handwheels, fastened to valve stem, for valves other than quarter turn.
 2. Lever Handle on quarter-turn valves 6 inch and smaller, except for plug valves. Provide one wrench for every 10 plug valves.
 3. Gear drive operators on quarter-turn valves 8 inches and larger.
- F. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

- G. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- H. End Connections: as specified in the individual valves specifications.
 - 1. Threads: Comply with ANSI B2.1.
 - 2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
 - 3. Solder-Joint: Comply with ANSI B16.18.
 - a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 GATE VALVES:

- A. Gate Valves - 2 Inch and Smaller: MSS SP-80; Class 125, body and bonnet of ASTM B 62 cast bronze, threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Class 150 and Class 250 valves meeting the above shall be used where pressure requires.

<u>MANUFACTURER</u>	<u>THREADED</u>		<u>SOLDER</u>	
	<u>NRS</u>	<u>RS</u>	<u>NRS</u>	<u>RS</u>
Crane	438	428	1701S	1700S
Milwaukee	105	148	115	1149
Powell	507	500	1822	1821
Stockham	B-130	B-100	B-104	B-108

- B. Gate Valves - 2 Inch and Smaller: MSS SP-80; Class 150, body and union bonnet of ASTM B 62 cast bronze, threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Do not use solder end valves for hot water heating or steam piping applications.

<u>MANUFACTURER</u>	<u>THREADED</u>		<u>SOLDER</u>	
	<u>NRS</u>	<u>RS</u>	<u>NRS</u>	<u>RS</u>
Crane	x	431UB	x	x
Milwaukee	x	1151	x	1169
Powell	2712	2714	x	1842
Stockham	B-130	B-120	x	B-124

- C. Gate Valves - 2-1/2 Inch and Larger: MSS SP-70; Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B, flanged ends, and "Teflon" impregnated packing and two-piece packing gland assembly.

<u>MANUFACTURER</u>	<u>OS&Y RS</u>	<u>NRS</u>
Crane	465-1/2	461
Milwaukee	F-2885	F-2882
Stockham	G-623	G-612
Powell	1793	1787

- D. NOTE: Use valves similar to above (Paragraphs A through C) except Class 250 on steam and condensate return systems where pressure is above 15 PSI.

2.4 BALL VALVES:

- A. All shut-off valves on water lines 2" and less used for domestic water or HVAC water shall be ball valves.
- B. Ball Valves - 1 Inch and Smaller: rated for 150 psi saturated steam pressure, 400 psi WOG pressure; 2-piece construction, bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Use extended stem length where insulation occurs.

<u>MANUFACTURER</u>	<u>THREADED</u>	<u>SOLDER</u>
	<u>ENDS</u>	<u>ENDS</u>
Conbraco (Apollo)	70-100	70-200
Crane	9302	9322
Jamesbury	351	x
Metraflex	IT	IS
Powell	4210T	x
Stockham	S-216 BR-R-T	S-216 BR-R-S
Watts	B-6000	B-6001

- C. Ball Valves - 1-1/4 Inch to 2 Inch: rated for 150 psi saturated steam pressure, 400 psi WOG pressure; 3-piece construction, bronze body conforming to ASTM B 62, full size port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Use extended length stem where insulation occurs.

<u>MANUFACTURER</u>	<u>THREADED</u>	<u>SOLDER</u>
	<u>ENDS</u>	<u>ENDS</u>
Conbraco (Apollo)	82-100	82-200
Powell	4201R	x
Watts	B-6800	B-6801

For grooved end connections use Victaulic Style 721.

2.5 PLUG VALVES:

- A. Plug Valves - 2 Inch and Smaller: 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends.

Lunkenheimer: 454.

- B. Plug Valves - 2-1/2 Inch and Larger: MSS SP-78; 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends.

Nordstrom: 143.

Powell: 2201.

2.6 GLOBE VALVES:

- A. Globe Valves - 2 Inch and Smaller: MSS SP-80; Class 125, body and screwed bonnet of ASTM B 62 cast bronze, threaded or solder ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Class 150 valves meeting the above shall be used where pressure requires.

<u>MANUFACTURER</u>	<u>THREADED</u>	<u>SOLDER</u>
Crane	1	1310
Milwaukee	502	1502
Powell	650	1823
Stockham	B-16	B-14T

- B. Globe Valves - 2 Inch and Smaller: MSS SP-80; Class 150, body and union bonnet of ASTM B 62 cast bronze, threaded ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel.

Crane: 17TF.
 Milwaukee: 590.
 Powell: 150.
 Stockham: B-22.

- C. Globe Valves - 2-1/2 Inch and Larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing and two-piece backing gland assembly.

	STRAIGHT	ANGLE
<u>MANUFACTURER</u>	<u>BODY</u>	<u>BODY</u>
Crane	351	353
Milwaukee	F2981	F2986
Powell	241	243
Stockham	G-512	G-515

2.7 BUTTERFLY VALVES:

- A. Butterfly Valves - 2-1/2 Inch and Larger: MSS SP-67; 200 psi, cast iron body conforming to ASTM A 126, Class B. Valves shall have field replaceable EPDM sleeve, with nickel-plated ductile iron disc, stainless steel stem, and EPDM O-ring stem seals. Sizes 2 through 6 inches shall have lever operators with locks, and sizes 8 through 24 inches shall have gear operators with position indicator. Valves on dead end service or requiring additional body strength shall be lug-wafer type, drilled and tapped.

MODEL NUMBERS FOR NICKEL-PLATED DUCTILE IRON DISCS

<u>MANUFACTURER</u>	<u>WAFER</u>		<u>LUG</u>	
	<u>LEVER</u>	<u>GEAR</u>	<u>LEVER</u>	<u>GEAR</u>
Center Line	Series A		Series LT	
Crane	12		14	
Conbraco-Apollo	6X-13X-01		6L-13X-01	
		6W-13X-02		6L-13X-02
Keystone	239		129	
Powell	1011-DA1		5011-DA1	
Stockham	LG-512-DS3E		LG-712-DS3E	
		LG-522-DS3E		LG-722-DS3E
Watts	BF-04-111-11		BF-03-111-11	
		BF-04-111-12		BF-03-111-12

Grooved Ends: Victaulic Series 700 and 300.

2.8 CHECK VALVES:

- A. Swing Check Valves - 2 Inch and Smaller: MSS SP-80; Class 125, cast bronze body and cap conforming to ASTM B 62, horizontal swing, Y-pattern, with a bronze disc, and having threaded or solder ends. Valve shall be capable of being reground while the valve remains in the line. Class 150 valves meeting the above specifications may be used where pressure requires or Class 125 are not available.

	CLASS 125		CLASS 150
	THREADED	SOLDER	THREADED
<u>MANUFACTURER</u>	<u>ENDS</u>	<u>ENDS</u>	<u>ENDS</u>
Crane	37	1342	137
Milwaukee	509	1509	510
Powell	578	1825	596
Stockham	B-319	B-309	B-321

For grooved connections use Victaulic Series 712.

- B. Swing Check Valves - 2 Inch and Smaller: MSS SP-80; Class 150, cast bronze body and cap conforming to ASTM B62, horizontal swing, Y-pattern, with a bronze disc, and having threaded ends. Valve shall be capable of being reground while the valve remains in the line.

Crane: 137.
 Milwaukee: 510.
 Powell: 596.
 Stockham: B-321.

For grooved connections use Victaulic Series 711, 715 or 716.

- C. Swing Check Valves - 2-1/2 Inch and Larger: MSS SO-71: Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.

<u>MANUFACTURER</u>	<u>CLASS 125</u>	<u>CLASS 175</u>
Crane	373	X
Milwaukee	F2974	X
Powell	559	X
Stockham	G-931	G-940

- D. Wafer Check Valves - (Non-Slam): Class 250, cast iron body, replaceable lapped bronze seat, lapped and balanced twin bronze flappers and stainless steel trim. Valve shall be designed to open and close at approximately one foot differential pressure. Twin flappers shall be loaded with a stainless steel torsion spring to minimize flapper drag and assure even non-slam checking action.

Bell & Gossett: NS.
Center Line: CLC.
Metraflex: Chexx.
Mission: 12 HMP.
Stockham: WG970.

2.9 GATE VALVE (RESILIENT SEAT)

- A. Manufacturers: Mueller, Kennedy or approved equal.
- B. Resilient seat gate valve: Gate valve shall be designed for a working pressure of not less than 150 pounds per square inch. Valves shall have joints as required for the piping in which they are installed. Valves shall have a smooth unobstructed waterway as large as the inside pipe diameter it is intended for. Valves shall have a non-rising stem, be equipped with an operating nut and be opened by turning counter clockwise. Valve shall be iron bodied with epoxy coating and be equipped with a bubble tight synthetic coated cast iron disc. Valve shall operate in full compression seating and must meet or exceed all the requirements of the latest revision of AWWA C-509.

2.10 GENERAL

- A. Provide all valves required for operation, service, and maintenance of systems and equipment, i.e. shut off valves both sides of equipment, coils, etc., balancing valves at leaving sides of coils, etc.
- B. Cut off valves in general shall be gate or butterfly valves. All shut-off valves on HVAC and domestic water lines 2" and smaller shall be ball valves.
- C. Throttling valves shall be ball or globe valves.
- D. Flow control valves shall be plug valves.
- E. Standard valves shall have 125 psi. working steam pressure or 200 psi. for water, oil and gas. Valves on steam systems above 15 psi (including steam return piping) shall have 250 or 300 psi working steam pressure.

- F. Sweat joint valves shall be used on all copper pipe.
- G. All gate and globe valves shall be designed for repacking under pressure when fully opened, and shall be equipped with packing suitable for the intended service. When the valve is fully opened, the back seat shall protect the packing and the stem threads from the fluid. All gate and globe valves shall have a gland follower. The pressure-temperature rating of valves shall be not less than the design criteria applicable to all components of the system.
- H. Bronze valves with the basic saturated steam rating of 125 psi or 150 psi shall have pressure containing parts of a material having at least the physical properties of ASTM Specification B-62. Metallic seated bronze globe, angle, check and gate valves with a basic steam rating of 200 or 300 psi shall have pressure containing parts of material conforming to ASTM Specification B-61, for temperatures to 550·F.
- I. Pressure containing parts of iron body valves shall be of material conforming to ASTM Specification A-126 Grade B. If the wedge in OS&Y gate valves is fastened to the stem by threads, it shall be secured by a nickel alloy or monel pin.
- J. Face-to-face and end-to-end dimensions of iron body valves shall conform to ANSI B16.10. Design, workmanship, materials, and testing shall conform to MSS-SP-70 and MSS-SP-71 (Manufacturers Standardization Society of the Valve and Fitting Industry).
- K. Stems of bronze and Iron Bodied Bronze Mounted valves shall be of ASTM-B-198 Class 13C (cast silicon brass), ASTM B-371, Alloy A (rolled silicon brass), or other material equally resistant to dezincification.
- L. All pressure casting shall be free of any impregnating materials.
- M. Gate valves shall be of the solid wedge type, designed and manufactured in such a way that seating surfaces are prevented from contacting until near the point of closure. Valves two inches and smaller shall be rising stem with threaded, solder, socket, or flanged end to suit service. Valves 2 1/2" and larger shall be flanged, and unless otherwise specified all shall be OS&Y.

- N. Globe valves two inches and smaller shall be threaded, flanged, solder end or socket end, to suit service. Globe valves 2 1/2 inches and larger shall be flanged, unless otherwise specified. Where composition discs are used, the disc shall be suitable for the intended service. For steam throttling service, composition disc valves shall be fitted with throttling nut. Metal seated globe valves shall have hardened stainless steel disc and seat ring.
- O. By-pass valves shall be globe type, and these two inches and smaller at pressure reducing stations, shall be 500 Brinell plug disc and seat ring type, or stellite. Those 2 1/2 inches through four inches shall be hardened stainless steel plug disc globe valves.
- P. Unless a composition disc is specified, swing check valves two inches and smaller shall be bronze, regrinding, with seating angle 40 to 45 degrees. A stop plug is required as a renewable stop for the hanger, unless otherwise specified. Disc and hanger shall be separate parts, and the disc shall be free to rotate. Hanger pins shall be supported on both ends by removable side plugs.
- Q. Lift check valves two inches and smaller shall be bronze or forged steel, to suit the service.
- R. Check valves 2 1/2 inches and larger shall be flanged, swing type, unless otherwise specified.
- S. Butterfly valves shall conform to MSS-SP-67. Liners and discs shall be suitable for the intended service.
- T. Butterfly valves shall be lug type suitable for dead end service. Body constructed of cast or ductile iron - heavy duty stem bushing to absorb operator side thrust - stainless steel stem - EPDM seat - operators with ten position lever lock for sizes 2 1/2" thru 6" - wormgear with handwheel for sizes above 6" - valve pressure rated for 150 psig at 180°F.
- U. All steam valves installed in boiler room must conform to ASME Boiler Code Specifications.
- V. Each valve is to be given shell and seat tests by the manufacturer and will carry a permanently affixed indication that tests have been successfully completed.

- W. Insofar as possible, all valves of the same type shall be of the same manufacturer. Before purchasing any valve, contractor shall submit for approval the name of the manufacturer, the figure number which he proposes to furnish, and engineering data on each figure number, if not using those specified. The intent of this requirement is to obtain the most suitable valve for each service. Nonstandard valves will not be considered.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine valve interior through the end ports, for cleanliness, freedom from foreign matter and corrosion. Remove special packing materials, such as blocks used which prevents disc movement during shipping and handling.
- B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the position in which it was shipped.
- C. Examine threads on both the valve and the mating pipe for form (out-of-round or local indentation) and cleanliness.
- D. Examine mating flange faces for conditions which might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size and material, and for freedom from defects and damage.
- E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.
- F. Replace defective valves with new valves.

3.2 VALVE SELECTION:

- A. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select valves with the following ends or types of pipe/tube connections:

Copper Tube Size 2 Inch and Smaller: Solder ends.

Steel Pipe Sizes 2 Inch and Smaller: threaded or grooved-end.

Steel Pipe Sizes 2-1/2 Inch and Larger: grooved-end or flanged.

3.3 VALVE INSTALLATIONS:

- A. General Application: Use gate, ball, and butterfly valves for shut-off duty; globe, ball, and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shut-down. Unions are not required on flanged devices.
- D. Install 3-valve bypass around each pressure reducing valve using throttling type valves.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Install in horizontal position with hinge pin level.
 - 2. Wafer Check Valves: Install between 2 flanges in horizontal or vertical position.
- G. Install resilient seat gate valves in the waste line at the kitchen to isolate the commutator.

3.4 SOLDER CONNECTIONS:

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket, using steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket in same manner.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open gate and globe valves to fully open position.
- E. Remove the cap and disc holder of fully open position.

- F. Remove the cap and disc holder of swing check valves with composition discs.
- G. Insert tube into valve socket making sure the end resets against the shoulder inside valve. Rotate tube or valve slightly to insure even distribution of the flux.
- H. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating the valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.5 THREADED CONNECTIONS:

- A. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
- D. Assemble joint wrench tight. Wrench on valve shall be on the valve and into the pipe is being threaded.

3.6 FLANGED CONNECTIONS

- A. Align flanges surface potential.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using a torque wrench.
- C. For dead end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.7 FIELD QUALITY CONTROL:

- A. Testing: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect each valve for leaks. Adjust or replace gaskets and/or packing to stop leaks, replace valve if leak persists.

3.8 ADJUSTING AND CLEANING:

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare to receive finish painting or insulation.

3.9 VALVE PRESSURE CLASSIFICATION SCHEDULES

<u>SERVICE</u>	<u>GATE</u>	<u>GLOBE</u>	<u>BALL</u>	<u>CHECK</u>
Chilled Water	125	125	150	125
Domestic Hot and Cold Water	125	125	150	125
Heating Hot Water	150	150	150	150
Steam (15 PSI And Less)	150	150		150
Steam (15 PSI to 125 PSI)	250	250		250

END OF SECTION 15100

SECTION 15135 - METERS AND GAGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-15 Basic Materials and Methods section, and is a part of each Division-15 section making reference to meters and gages specified herein.

1.2 DESCRIPTION OF WORK:

- A. Extent of meters and gages required by this section is indicated on drawings and/or specified in other Division-15 sections.
- B. Types of meters and gages specific in this section include the following:

Temperature Gages and Fittings.

Dial Type Insertion Thermometers.
Thermometer Wells.
Temperature Gage Connector plugs.

Pressure Gages and Fittings.

Pressure Gages.
Pressure Gage Cocks.
Pressure Gage Connector Plugs.
Trumpet Valves.

Flow Measuring Gages.

Wafer-Type Flow Meters.
Calibrated Balance Valves.

Temperature and Pressure Gage connector Plugs.
Automatic Flow Control Valves.

- C. Meters and gages furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-15 sections.

1.3 QUALITY ASSURANCE:

- A. Manufacturers Qualifications: Firms regularly engaged in manufacturer of meters and gages, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - UL Compliance: Comply with applicable UL standards pertaining to meters and gages.
 - ANSI and ISA Compliances: Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.
- C. Certification: Provide meters and gages whose accuracies, under specified operating conditions, are certified by manufacturer.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of meter and gage. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.
- B. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gage. Include this data and product data in Maintenance Manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 DIRECT MOUNT DIAL THERMOMETERS:

- A. General: Provide direct mount dial thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
- B. Type: Vapor tension, universal angle.
- C. Case: Drawn steel or brass, glass lens, 4-1/2" diameter.
- D. Adjustable Joint: Die cast aluminum, 180 deg adjustment in vertical plane, 360 deg adjustment in horizontal plane, with locking device.

- E. Thermal Bulb: Copper with phosphor bronze bourdon pressure tube, on scale division accuracy.
- F. Movement: Brass precision geared.
- G. Scale: Progressive, satin faced, non-reflective aluminum, permanently etched markings.
- H. Stem: Copper plated steel, or brass, for separable socket, length to suit installation.
- I. Range: Conform to the following:
 - Hot Water: 40 deg - 240 deg F (10 deg F Graduations).
 - Chilled Water: 0 deg. - 100 deg. (1 deg. F Graduations).
- J. Manufacturer: Subject to compliance with requirements, provide direct mount dial thermometers of one of the following:
 - Marsh Instrument Co., Unit of General Signal.
 - Treerice (H.O.) Co.
 - Weiss Instruments, Inc.
 - Weksler

2.2 THERMOMETER WELLS:

- A. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.
- B. Manufacturer: Same as thermometers.

2.3 PRESSURE GAGES:

- A. General: Provide pressure gages of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
- B. Type: General use, 1% accuracy, ANSI B 40.1 grade A, phosphor bronze bourdon type, bottom connection.
- C. Case: Drawn steel or brass, glass lens, 4-1/2" diameter.

- D. Connector: Brass with 1/4" male NPS. Provide protective syphon when used for steam service.
- E. Scale: White coated aluminum, with permanently etched markings.
- F. Range: Conform to the following:
 - Water: 0 - 100 psi AND 0 - 230 feet of water.
 - Steam: (Low Pressure) 0 - 30 PSI
 - Steam: (High Pressure) 0 - 200 PSI
 - Air: 0 - 250 PSI
- G. Manufacturer: Subject to compliance with requirements, provide pressure gages of one of the following, or an approved equal:
 - Ametek/U.S. Gauge
 - Marsh Instrument Co., Unit of General Signal.
 - Marshalltown Instruments, Inc.
 - Terice (H.O.) Co.
 - Weiss Instruments, Inc.
 - Weksler
- H. Snubber: 1/4" brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.
- I. Manufacturer: Same as for pressure gages.

2.4 TRUMPET VALVE:

- A. Features: Spring return pushbutton manifold two, three, or four port as required - brass construction - system connection ports as indicated on plans test port connection for valve calibration.
- B. Accessories: Heavy duty mounting bracket, pressure gauge calibrated in feet of water, and pounds per square inch. Rotating dial that allows reading of differential pressure.
- C. Locate at convenient height for reading gauge and push button operation.
- D. Manufacturers: Flow Conditioning Corp. or approved equal.

2.5 TEMPERATURE AND PRESSURE GAGE CONNECTOR PLUGS (PETE'S PLUG):

- A. General: Provide pressure gage connector plugs pressure rated for 500 psi and 200 deg F. Construct of brass and finish in nickel-plate, equip with 1/2" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly from dial type insertion pressure gage or temperature gage. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.
- B. Manufacturer: Subject to compliance with requirements, provide pressure gage connector plugs of one of the following, or approved equal:

Peterson Engineering Co.
Sysco

2.6 CALIBRATED BALANCE VALVES:

- A. General: Provide as indicated, calibrated balance valves equipped with readout valves to facilitate connecting of differential pressure meter to balance valves. Equip each readout valve with integral EPT check valve designed to minimize system fluid loss during monitoring process. Provide calibrated nameplate to indicated degree of closure of precision machined orifice. Construct balancing valve with internal EPT O-ring seals to prevent leakage around rotating element. Provide balance valves with preformed polyurethane insulation suitable for use on heating and cooling systems, and to protect balance valves during shipment.
- B. Type: Provide a circuit setter balance valve for pipe sizes 3" and smaller. Provide circuit sensor orifice plate flow meter for pipe sizes 4" and larger, where flow measurement only is required, and the flow can be throttled by a separate balance valve, otherwise provide circuit setter balance valve.
- C. Installation: Install flow meter at all hot water, chilled water, and heat recovery coil pumps, and at all coils and elsewhere as indicated on plans. Install per manufacturer's instructions.
- D. Circuit Setter Features: Bronze/cast iron with bronze disc balance valve with provisions for connecting a portable differential pressure meter. Meter connections to have built-in check valves. An integral pointer shall register degree of valve opening with a calibrated scale and each unit shall have a "Memory Stop" which can be field set. Each balance valve to be constructed with internal seals to prevent leakage around rotating element. Each balance valve shall be constructed for 125 psig working pressure at a maximum temperature of 250·F. and supplied with preformed polyurethane insulation suitable for use on heating and cooling systems.

- E. Orifice Plate Flow Meter Features: Bell and Gossett Model OP, Armstrong, or approved equal. Cast iron wafer-type flow meter with plated orifice and readout plugs with integral check valve. The readout plugs shall facilitate connecting and disconnecting a differential meter to and from the flow meter. The flow meter shall be furnished with a calibrated nameplate detailing a range of differential head pressures and operating flow range for the orifice insert.
- F. Manufacturer: Subject to compliance with requirements, provide calibrated balance valves of one of the following:

Bell & Gossett ITT; Fluid Handling Div. Model CB (1/2" Thru 4")
Armstrong Model CBVI (1/2" Thru 2") or CBVII (2 1/2" Thru 10")

2.7 AUTOMATIC FLOW CONTROL VALVE

- A. Manufacturer: Griswold, Auto flow, or an approved equal.
- B. Capacity: Flow rate to match equipment served, regardless of system pressure fluctuation, within $\pm 5\%$. Control range shall be 1 to 14 PSI, 2 to 32 PSI, 4 to 57 PSI or 8 to 128 PSI depending on location within the piping system.
- C. Submittal shall include a schedule which delineates the control range for each specific flow controller at every unit along with the valve size.
- D. Features: All internal working parts shall be of passivated stainless steel or nickel plated brass. The valve shall be tamperproof when installed. Body pressure tappings suitable for pressure gauge and thermometer installation and verification of pressure differential across valve orifice shall be provided - Bronze body - 150 PSI and 250-F rating - Units 1 1/2" and smaller located at coils shall have female threaded ball valve with lever handle on system side of controller for isolation with female sweat connection on unit side. A metal identification tag on chain will be provided for each valve. The tag will give valve model number, rated flow GPM, absorption range. Units 3" and above shall be gray iron body Class 150 for flanged installation.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which meters and gages are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF TEMPERATURE GAGES:

- A. General: Install temperature gages in vertical upright position, and tilted so as to be easily read by observer standing on floor.
- B. Locations: Install in the locations indicated on the plans and:
 - At discharge of each pump.
 - At inlet and outlet of each converter.
 - At CWS inlet and CWR outlet at each building.
- C. Remote Reading Dial Thermometers: Install on control panels as indicated. Run tubing between panel, and thermometer bulb, adequately supported to prevent kinks. Select tubing length so as to not require coiling of tubing.
- D. Thermometer Wells: Install in piping tee where indicated, in vertical upright position. Fill well with oil or graphite, secure cap.
- E. Temperature Gage Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap. Locate at inlet and outlet of each coil.

3.3 INSTALLATION OF PRESSURE GAGES:

- A. General: Install pressure gages in piping tee with pressure gage cock, located on pipe at most readable position.
 - B. Locations: Install in the following locations, and elsewhere as indicated:
 - Install trumpet with pressure gage piped across suction and discharge of each hydronic pump, as detailed on plans.
 - Install pressure gage at inlet and discharge of each steam pressure reducing station and at domestic water inlet to each building and at CWS inlet and CWR outlet at each building.
 - Install pressure gage at domestic water inlet to building.
- Pressure Gage Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap. Locate at inlet and outlet of each coil.

3.4 INSTALLATION OF FLOW MEASURING GAGES:

A. General: Install flow measuring gages on piping systems located in accessible locations at most readable position.

B. Locations: Install in the following locations, and elsewhere as indicated.

Locate at either suction or discharge pipe of each new pump.

Locate at outlet of each heat recovery coil, hot water and chilled water coil.

C. Calibrated Balance Valves: Install on piping with readout valves in vertical upright position. Maintain minimum length of straight unrestricted piping equivalent to 3 pipe diameters upstream of valve, and 2 pipe diameters downstream of valve, or as required by the Manufacturer.

3.5 ADJUSTING AND CLEANING:

A. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

END OF SECTION 15135

SECTION 15140 - SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-15 "BASIC MATERIALS AND METHODS" section, and is a part of each Division-15 section making reference to supports and anchors specified herein.

1.2 DESCRIPTION OF WORK:

- A. Extent of supports and anchors required by this section is indicated on drawings and/or specified in other Division-15 sections.
- B. Types of supports and anchors specified in this section include the following:

Horizontal-Piping Hangers and Supports.

Vertical-Piping Clamps.

Hanger-Rod Attachments.

Building Attachments.

Saddles and Shields.

Spring Hangers and Supports.

Miscellaneous Materials.

Roof Equipment Supports.

Anchors.

Equipment Supports.

- C. Supports and anchors furnished as part of factory-fabricated equipment, are specified as part of the equipment assembly in other Division-15 sections.
- D. Provide seismic restraints as required to comply with BOCA and local codes.

1.3 QUALITY ASSURANCE:

- A. **Manufacturers Qualifications:** Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
2. UL and FM Compliance: Provide products which are UL-listed and FM approved.
3. MSS Standard Compliance:

Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

Select and apply pipe hangers and supports, complying with MSS SP-69.

Fabricate and install pipe hangers and supports, complying with MSS SP-89.

Terminology used in this section is defined in MSS SP-90.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly or components.
- C. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Use strap type pipe ring hangers on pipe up thru 3" equal to Grinnel fig. 69 or CT-69. Use standard duty clevis hangers on piping larger than 3" equal to Grinnel Fig. 260. Use pipe roll hangers as indicated on the drawings.

- B. Use inserts or supporting members in construction above for overhead suspension. Set inserts or supporting members for hangers in form for concrete construction. Use expansion inserts only where approved by the Architect.
- C. Use heavy welded steel brackets for wall suspension. Mount brackets and wall supports on masonry walls and bolts through the wall and a suitable steel back plate on the back of the wall.
- D. All heating hot water supply and return piping 6" line size and larger located at boiler room shall have adjustable constant support tension springs hangers equivalent to Grinnell No. 81H.
- E. The hot water main at each boiler, and the header shall be installed with cold set equal to expected expansion, such that when hot, the piping is true and parallel to the walls.

2.2 HORIZONTAL-PIPING HANGERS AND SUPPORTS:

- A. General: Except as otherwise indicated, provide factory-abricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

Adjustable Steel Clevis Hangers: MSS Type 1.

Yoke Type Pipe Clamps: MSS Type 2.

Steel Double Bolt Pipe Clamps: MSS Type 3.

Steel Pipe Clamps: MSS Type 4.

Pipe Hangers: MSS Type 5.

Adjustable Swivel Pipe Rings: MSS Type 6.

Adjustable Steel Band Hangers: MSS Type 7.

Adjustable Band Hangers: MSS Type 9.

Adjustable Swivel Rings, Band Type: MSS Type 10.

Split Pipe Rings: MSS Type 11.

Extension Split Pipe Clamps: MSS Type 12.

U-Bolts: MSS Type 24.

Clips: MSS Type 26.

Pipe Saddle Supports: MSS Type 36, including steel pipe base-support and cast-iron floor flange.

Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.

Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast-iron floor flange.

Single Pipe Rolls: MSS Type 41.

Adjustable Roller Hangers: MSS Type 43.

Pipe Roll Stands: MSS Type 44.

Pipe Rolls and Plates: MSS Type 45.

Adjustable Pipe Roll Stands: MSS Type 46.

2.3 VERTICAL-PIPING CLAMPS:

- A. General: Except as otherwise indicated, provide factory- fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.
- B. Two-Bolt Riser Clamps: MSS Type 8.
- C. Four-Bolt Riser Clamps: MSS Type 42.

2.4 HANGER-ROD ATTACHMENTS:

- A. General: Except as otherwise indicated, provide factory- fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

Steel Turnbuckles: MSS Type 13.

Steel Clevises: MSS Type 14.

Swivel Turnbuckles: MSS Type 15.

Malleable Iron Sockets: MSS Type 16.

Steel Weldless Eye Nuts: MSS Type 17.

2.5 BUILDING ATTACHMENTS:

- A. General: Except as otherwise indicated, provide factory- fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

Top Beam C-Clamps: MSS Type 19.

Side Beam or Channel Clamps: MSS Type 20.

Center Beam Clamps: MSS Type 21.

Welded Beam Attachments: MSS Type 22.

C-Clamps: MSS Type 23.

Top Beam Clamps: MSS Type 25.

Side Beam Clamps: MSS Type 27.

Steel Beam Clamps W/Eye Nut: MSS Type 28.

Linked Steel Clamps W/Eye Nut: MSS Type 29.

Malleable Beam Clamps: MSS Type 30.

Steel Brackets: One of the following for indicated loading:

Light Duty: MSS Type 31.

Medium Duty: MSS Type 32.

Heavy Duty: MSS Type 33.

Side Beam Brackets: MSS Type 34.

Plate Lugs: MSS Type 57.

Horizontal Travelers: MSS Type 58.

2.6 SADDLES AND SHIELDS:

- A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.
- B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
- C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:

Elcen Metal Products Co.
Pipe Shields, Inc.

2.7 MANUFACTURERS OF HANGERS AND SUPPORTS:

- A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

B-Line Systems, Inc.
Fee & Mason Mfg. Co., Div. Figgie International.
ITT Grinnel Corp.

2.8 MISCELLANEOUS MATERIALS:

- A. Metal Framing: Provide products complying with NEMA STD ML 1.
- B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.
- C. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION:

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS:

- A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.
- B. Use powder driven anchors or expansion anchors at concrete structure.

- C. Install supplementary steel angles, fastened or welded to building structure as required to support pipe and accessories. Use 3" x 5" x 1/4" steel angle with long leg vertical, or heavier if required.

3.4 INSTALLATION OF HANGERS AND SUPPORTS:

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Space hangers 5'-0" on center for steel, iron, and copper pipe up to and including 1 1/2" nominal size.
- C. Space hangers 10'-0" on center for steel, iron, and copper pipe above 1 1/2", or as otherwise shown on the drawings. Piping size 12" and above shall have hanger spacing at 12'-0" maximum, unless shown otherwise on the drawings.
- D. Space hangers 5'-0" on center for cast iron soil pipe.
- E. Space hangers 4'-0" on center for PVC and ABS plastic piping.
- F. Mount piping so that all runs are parallel and evenly spaced.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as install for adjacent similar piping.
- H. Support fire-water piping independently of other piping.
- I. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.
- J. Provisions for Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- K. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.
- M. Insulated Piping: Comply with the following installation requirements: Size hangers on insulated pipe 3" and smaller to fit the pipe. Use copper plated hangers for copper pipe. Size hangers on insulated pipe 4" and larger to fit the insulation, and provide pipe sleeves and high density insulation inserts as specified under "Insulation and Pipe Covering".
 - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
 - 2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. For pipe 8" and over, install wood insulation saddles.
 - 3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.5 INSTALLATION OF ANCHORS:

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and FASTEN to structure. Comply with ANSI B31 and with AWS standards.

3.6 EQUIPMENT SUPPORTS:

- A. Concrete housekeeping bases will be provided as work of Division 3. Furnish to Contractor, scaled layouts of all required bases, with dimensions of bases, and location to column center lines. Furnish templates, anchor bolts, and accessories, necessary for base construction.

3.7 ADJUSTING AND CLEANING:

- A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.8 SEISMIC REQUIREMENTS:

- A. Install all hangers, supports, and anchors to comply with BOCA and local codes.

END OF SECTION 15140

SECTION 15190 - MECHANICAL IDENTIFICATION:

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-15 Basic Materials and Methods section, and is part of each Division-15 section making reference to identification devices specified herein.

1.2 DESCRIPTION OF WORK:

- A. Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division-15 sections.
- B. Types of identification devices specified in this section include the following:
 - Plastic Pipe Markers.
 - Underground-Type Plastic Line Marker.
 - Valve Tags.
 - Valve Schedule Frames.
 - Equipment Nameplates
- C. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of the equipment assembly in other Division-15 sections.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.
- C. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering mechanical identification materials which may be incorporated in the work include, but are not limited to, the following:
- B. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:

Allen Systems, Inc.
Brady (W.H.) Co.; Signmark Div.
Industrial Safety Supply Co., Inc.
Seton Name Plate Corp.

2.2 MECHANICAL IDENTIFICATION MATERIALS:

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-15 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PLASTIC PIPE MARKERS:

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.
- B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.
- C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 deg F (52 deg C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
- D. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - 1. Snap-On application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Adhesive lap joint in pipe marker overlap.
 - 3. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".
- E. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
 - 1. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide, full circle at both ends of pipe marker, tape lapped 3".
 - 3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

- F. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.
- G. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.
 - 1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.4 UNDERGROUND-TYPE PLASTIC LINE MARKERS:

- A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.
 - 1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.5 VALVE TAGS:

- A. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/2" sq. black tags with white lettering, except as otherwise indicated.
 - 2. Provide size, shape and color combination as specified or scheduled for each piping system.
- B. Valve Tag Fasteners: Manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.
- C. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.6 VALVE SCHEDULE FRAMES:

- A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.7 LETTERING AND GRAPHICS:

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
 - 1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

2.8 EQUIPMENT NAMEPLATES

- A. Nameplates shall be laminated phenolic plastic black front and back with white core. Lettering shall be engraved through front layer to form 1/4" white characters. Nameplates shall be securely fastened to the equipment to be identified, with No. 4 Phillips, round head, cadmium plated, steel self tapping screws or nickel plated brass bolts. In lieu of separate plastic nameplates, engraving directly on device plates is acceptable. Letters engraved thus, shall be filled with contrasting enamel. All nameplates and their installation are part of this work. Free hand lettering or dymo label marker will not be acceptable.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

- A. General Installation Requirements:
 - 1. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION:

- A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
 - 1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

- B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) exterior non-concealed locations, and piping above lay-in ceilings.
 - 1. Near each valve and control device.
 - 2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 - 3. Near locations where pipes pass through walls or floors/ ceilings, or enter non-accessible enclosures.
 - 4. At access doors, manholes and similar access points which permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
 - 7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
 - 8. Locate pipe markers on all medical and dental gas piping (air vacuum and oxygen) at 20' spacing.

3.3 VALVE IDENTIFICATION:

- A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
- B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
 - 1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

3.4 EQUIPMENT IDENTIFICATION

- A. General: The following items shall be equipped with nameplates:
 - 1. Air Handling Units and/or rooftop HVAC equipment.
 - 2. Exhaust fans
 - 3. Pumps
 - 4. Boilers and Chillers
- B. Inscription: Nameplates shall adequately describe the function or use of the particular equipment involved. The name used for a machine nameplate shall be the same as the one used on the contract drawings.

END OF SECTION 15190

SECTION 15200 - NOISE AND VIBRATION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of Vibration Isolation work is indicated on drawings and schedules, and by requirements of this section.
- B. Expected noise levels in various parts of the building shall generally conform to noise criteria recommendations as set forth in the 1970 A.S.H.R.A.E. guide and data book, Chapter 33, pages 513 to 518, as may be updated.
- C. Submittal data shall show type, size and deflection of each isolator proposed. All steel bases and concrete inertia bases shall be completely detailed, including O.D., free, operating and solid heights of the springs, isolation efficiency based on the lowest operating speed of the equipment supported and clearly outlining procedures for installing and adjusting the isolators.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Amber Booth Co. - Korfund Vibration Mountings Inc., -Consolidated Kinetic Corporation, Vibration Mountings, Inc. or Mason. All isolation equipment shall be furnished by a single manufacturer.
- B. Corrosion Protection:
 - 1. All vibration isolators and bases shall be designed or treated for resistance to corrosion.
 - 2. For indoor installations, steel components shall be PVC coated or phosphated and painted with industrial grade enamel. Bases shall thoroughly be cleaned of welding slag and primed.

3. For outdoor installations, all parts shall be aluminum, PVC coated, hot-dip galvanized, or zinc-electro plated, plus coating of neoprene or bitumastic paint.
4. All nuts, bolts, and washers shall be zinc-electro plated.

B. Design Requirements:

1. All rails, saddles, frames, and bases shall be supplied with equipment mounting templates or shall be drilled to receive the supported equipment.
2. All spring isolators shall be capable of 30% overtravel before becoming solid, and furnished complete with a ribbed neoprene pad bonded to the base plate.
3. All open spring type isolators shall be designed stable, for a minimum KX/KY (horizontal to vertical spring rate) of 1.0.
4. All mechanical equipment over 1 horsepower shall be isolated from the structure by means of resilient vibration and noise isolators, unless otherwise noted.
5. All minimum deflection for spring isolators shall conform to requirements of ASHRAE Chapter 35.

C. Isolate Piping as follows:

1. Isolate all suspended piping in the mechanical equipment rooms and all piping up to and including three supports away from mechanical equipment over 1 HP with combination spring and synthetic rubber hangers.
2. Isolate floor mounted piping with neoprene mounts.

D. Isolate equipment as follows:

1. Floor mounted Make-Up Air Units, Air Handling Units, Cabinet Exhaust Fans and Cabinet Relief Fans, with open spring mount; consisting of one or more coil springs enclosed in an adjustable telescoping cast iron or aluminum top and bottom section, separated by resilient neoprene inserts.

2. Isolate suspended Air Handling units with spring hanger consisting of a coil spring placed within a rectangular steel box.
3. Isolate air compressors and vacuum pumps with ribbed neoprene pad.
4. Isolate suspended supply air fan and return air/relief air fans with combination spring and synthetic rubber hangers.
5. Isolate roof or floor mounted make-up air units with spring isolation rails.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturers instructions.

END OF SECTION 15200

SECTION 15250 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of mechanical insulation required by this section is indicated on drawings, and by requirements of this section.
- B. Types of mechanical insulation specified in this section include the following:
 - 1. Piping System Insulation:
 - Domestic Water Piping Systems.
 - Storm Water Piping Systems.
 - Hot Water Piping Systems.
 - Chilled Water Piping Systems.
 - 2. Ductwork System Insulation:
 - Dual Temperature Ductwork.
 - 3. Equipment Insulation:
 - Bottom of Roof Drain Bodies.
 - Chilled Water Pumps
 - Expansion Tanks
 - Air Separators

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - Armstrong World Industries, Inc.
 - Certainteed Corp.
 - Schuller International (Johns-Manville Corp.)
 - Owens-Corning Fiberglas Corp.
 - Rubatex Corp.
 - American Thermal Products, Inc.
- C. Installer: A firm with at least 3 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- D. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM E 84 (NFPA 255) method.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's specifications and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, thickness, and furnished accessories for each mechanical system requiring insulation.
- B. Samples: Submit a sample of each type of insulation, clearly labeled, that is to be used on this project. Samples will be delivered to and retained by the Owners observer for comparing to actual installation.
- C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data in maintenance manual.
- D. Certifications: Submit certifications or other data as necessary to show compliance with these specifications and governing regulations. Include proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard ratings of products.
- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged insulation; remove from project site.

PART 2 - PRODUCTS

2.1 PIPE INSULATION MATERIALS:

- A. Features: All completed insulation of pipe and fittings shall have the following Underwriters Laboratories Fire Hazard Classification:
 - 1. Flame spread not to exceed - 25.
 - 2. Fuel contributed not to exceed - 50.
 - 3. Smoke developed not to exceed - 50.
- B. Three or Four (3 or 4 lb.) density glass fiber insulation used for all pipe covering in this section shall have a maximum "K" factor of .24 at 100°F. mean temperature.
- C. Insulate domestic hot water supply, domestic hot water recirculating line, heating water supply, heating water return piping with 1" thick glass fiber pipe insulation covered with factory applied flame retardant vapor barrier jacket. Insulate all piping 6" diameter and above with 2" thick glass fiber. Schuller Micro-Lock 850 fiberglass with AP-T Plus jacket or equal.
 - 1. Interior concealed fittings shall be insulated with flexible glass fiber to a thickness equal to the adjoining piping insulation. Finish by spiral wrapping with white vinyl.
 - 2. Interior exposed fittings shall be insulated with PVC fitting covers installed over flexible glass fiber inserts to a thickness equal to the adjoining pipe insulation. Schuller, Zeston or equal.

- D. Insulate chilled water supply and return, chilled drinking water, domestic cold water, soft cold water, internal rain leaders and downspouts with 1" thick glass fiber pipe insulation with factory applied flame retardant vapor barrier jacket Schuller Miro-Lok 850 fiberglass with AP-T Plus jacket or equal. Chilled Water Piping sizes 6" and above shall have 1.5 inch thick insulation.
1. Interior concealed fittings and pipe hangers shall be insulated with flexible glass fiber to a thickness equal to the adjoining pipe insulation. Finish by spiral wrapping with white vinyl and apply a brush coat of vapor barrier mastic. Childers CP-30 or equal.
 2. Interior exposed fittings shall be insulated with PVC fitting covers installed over flexible glass fiber inserts to a thickness equal to the adjoining pipe insulation. Manville Zestons or equal. Vapor seal all joints with Childers CP-30 or equal.
 3. Interior exposed pipe hangers for chilled water shall be insulated with 1/2" thick Armstrong Armaflex sheet insulation Type "FR". Insulation shall be field cut and formed for a neat finished appearance. Vapor seal all joints and Armaflex with Childers CP-30 or equal.
- E. Piping runouts 1" and less located in concealed walls or plumbing chases where space is limited may be insulated with 1/2" thick insulation in lieu of 1" thick.
- F. Provide high density inserts at hanger locations between the pipe and pipe shield for pipe sizes 4" and larger. Maintain a continuous vapor barrier through the hangers and match the jacketing of adjoining pipe insulation.
- G. Outdoor Piping (exposed to weather): Use the same insulation for interior exposed pipes carrying the same product and add: A jacket of .016 smooth sheet aluminum 3003 alloy, H-14 temper. Finish fittings with Foster Sealfas G-P-M 35-00 reinforced with Foster Mast-a-Fab.
- H. Insulate "P" trap and exposed hot water supply lines below handicapped accessible lavatories in one of the following manners:
1. Molded flexible vinyl insulation system, Model #101 "Handi Lav-Guard" as manufactured by Truebro.
 2. PVC 2 piece "P" trap cover with insulation tubing, "Trap-Guard" as manufactured by Buckaroos. Insulate hot water supply with 1/2" wall flexible closed-cell insulation with enamel coating.
 3. Other systems with prior approval only.

2.2 DUCTWORK SYSTEM INSULATION:

- A. Manufacturers: Schuller (Johns Manville) Microtex - Textra-fine -Certain-Teed/Saint - Gobain - Owens Corning.
- B. Insulate internally low velocity rectangular supply ducts, and return air ducts with 1/2" liner with a minimum density of 2.0 pounds per cu. ft. complying with TIMA AHC-101. Insulate fresh air ducts with 1.0" thick duct liner. Plenums at exterior louvers shall have duct wrap per Paragraph 2.4.E.
- C. Applied with coated side to air stream in cut to fit pieces fastened to interiors of duct with adhesive.
- D. Coat all exposed edges with Foster's Gray No. 30-70 Lagtone adhesive.
- E. Adhere liner to interior sides of duct with minimum 50% coverage of fire retardant adhesive such as Foster 85-11, Childers, or Minnesota Mining. Equivalent to comply with ASC-A-7001.
- F. Use mechanical fastening of Graham Welded Pins, or Stick-Klips on maximum 16" centers at top sections when width exceeds 12" and on sides when height exceeds 24". Pins shall comply with SMACNA MF-1.
- G. Apply a brush width of Foster's Fire Retardant Coating Gray No. 30-70 Lagtone over all joints, visible cut edges, and leading edges of insulation to prevent fiber erosion.
- H. DUCT SIZES ON DRAWINGS ARE FOR DIMENSIONS INSIDE OF LINING AND SHEET METAL SIZE SHALL BE INCREASED ACCORDINGLY. If adhesive is applied in shop use Foster Spark - FAS 85-11 if applied in field use Foster Spark - FAS Adhesive 85-20. Adhesives shall be approved and listed by Underwriters Laboratory and shall bear the U.L. Label.
- I. Density and thickness of duct liner shall be printed on the face of the liner by the manufacturer.
- J. Duct liner shall have an Underwriters Laboratories fire hazard rating with a flame spread not to exceed 25 and fuel contributed and smoke developed ratings not to exceed 50.

2.3 EQUIPMENT INSULATION MATERIALS

- A. Insulate all chilled water pumps with Armstrong Armaflex sheet insulation Type "FR" 1/2" thick, inside an aluminum box which is removable and sets over the pump.

- B. Insulate expansion tanks, inline air eliminators, roof drain sump bodies with Type "FR" 1/2" thick Armaflex sheet insulation in cut to fit pieces.

2.4 DUCT INSULATION (EXTERNAL)

- A. Manufacturers: Schuller (Manville) - Certain-Teed - Ultralite - Textra-Fine -Owens-Corning - E. O. Wood.
- B. Insulate externally all round and oval ducts, all rectangular supply air ducts which are noted or specified to have no duct lining, and all high velocity rectangular ducts with 1-1/2" thickness of .6 - .75 pound density fiberglass ductwrap with a Foil-scrim Kraft vapor barrier applied with outward-clinching staples.
- C. Insulation shall be continuous through partitions, coils, etc. Insulate fire damper sleeves to partitions.
- D. NOTE: Dual wall ducts with factory installed insulation need not be field insulated.
- E. Insulate externally all plenums directly behind louvers with 1" thick, 3 pound density board insulation with FAK facing. Apply over Insul-Anchors and secure with self-locking washers. Tape all joints and washers with 3" wide FSK tape to match the facing of the insulation.

PART 3 - EXECUTION

3.1 PLUMBING PIPING SYSTEM INSULATION:

- A. Insulation Omitted: Omit insulation on exposed plumbing fixture runouts from faces of wall or floor to fixture unless otherwise indicated on the plumbing fixture specifications; on unions, flanges, strainers, flexible connections, and expansion joints.

3.2 HVAC PIPING SYSTEM INSULATION:

- A. Insulation Omitted: Omit insulation on hot piping, on heating piping on and beyond control valve, located within heated space; on the heating coils. Omit insulation on unions, flanges, strainers, flexible connections, and expansion joints, on hot piping systems.

3.3 INSTALLATION OF PIPING INSULATION:

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

- B. Install insulation on pipe systems subsequent to testing and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Where insulation is terminated for piping accessories as noted above, the insulation thickness shall be tapered down to the pipe at a 45° angle with proper coating and sizing.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.
- F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- H. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.
- I. Pipe Hanger Insulation Inserts: Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3 inch wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3 inch wide vapor barrier tape or band.

3.4 INSTALLATION OF DUCTWORK INSULATION:

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation materials with smooth and even surfaces.

3.5 PROTECTION AND REPLACEMENT:

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 15250

SECTION 15325 - WET PIPE SPRINKLER SYSTEM

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Inside and outside wet piping, including sprinkler heads, valves, hangers and supports, sleeves, fire department connections, alarms and accessories. Provide risers as required for wet pipe systems.

1.2 RELATED WORK AND APPLICABLE REQUIREMENTS SPECIFIED ELSEWHERE

- A. DIVISION 1 - GENERAL REQUIREMENTS: These shall apply to all work included in this section.
- B. Related Work:
 - 1. DIVISION 3 - CONCRETE
 - 2. Section 15330 - AFFF Fire Suppression Systems
 - 3. Section 15335 - Fire Pump Systems
 - 4. Section 15340 - Fire Detection, Alarm and Equipment Activation Systems

1.3 APPLICABLE PUBLICATIONS: The publications listed below form a part to this specification to the extent referenced. The publications are referred to in the text by basic designation only.

- A. Federal Specifications (Fed. Spec.):

TT-E-489F Enamel, Alkyd, Gloss (For Exterior and
& AM 1 Interior Surface)

TT-P-645A Primer, Paint, Zinc Chromate, Alkyd type

- B. Military Specification (Mil. Spec.):

DOD-P-15328D Primer (Wash), Pre-Treatment (Formula No. 117 for Metals)
(Metric)

- C. American Society for Testing and Materials (ASTM) Publications:

A 53-86 Pipe, Steel, Black and Hot Dipped Zinc Coated (Galvanized)
Welded and Seamless for Ordinary Uses

A 120-86 Pipe, Steel, Black and Hot Dipped Zinc Coated (Galvanized)
Welded and Seamless for Ordinary Uses

D. American Water Works Association (AWWA) Publications:

C601-68 Disinfecting Water Mains.

E. Factory Mutual System (FM) Publications

1995 Approval Guide

F. National Fire Protection Association (NFPA) Publications:

13-94 Sprinkler Systems
24-92 Private Fire Service Mains

G. Underwriters' Laboratories, Inc. (UL) Publications:

1995 Fire Protection Equipment Listing

H. Department of the Air Force:

ETL-90-09 Engineering Technical Letter, as amended by attachment to
ANGRC/CEE and ANG/CEE review comments

1.4 QUALIFICATIONS OF INSTALLER: Prior to installation, submit data for approval by the Contracting Officer, showing that the Contractor has successfully installed automatic fire extinguishing sprinkler systems of the same type and design as specified herein. The data shall include the names and locations of at least two installations where the contractor has installed such systems. The Contractor shall indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. The design and installation of the wet pipe sprinkler systems shall be coordinated with the systems being furnished and constructed under **SECTIONS: AFFF FIRE SUPPRESSION SYSTEMS, FIRE PUMP SYSTEMS and FIRE DETECTION, ALARM AND EQUIPMENT ACTIVATION SYSTEMS**. All the work covered by these sections shall be the responsibility of one fire protection firm. This firm shall normally be engaged in the field of fire protection with a registered fire protection engineer on staff. Certification of this qualification shall be submitted for approval.

A. Description of Work:

1. The work includes designing and providing new automatic wet pipe fire extinguishing sprinkler systems for uniform distribution of water to afford complete fire protection coverage throughout the areas indicated for wet pipe sprinkler system(s) in the project drawings.

2. The design, equipment, materials, installation and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 13 and 24, except as modified herein. Include all materials, accessories and equipment necessary to provide each system complete and ready for use. Design and install each system to give full consideration to blind spaces, piping, electrical equipment, ductwork, and all other construction and equipment to afford complete coverage in accordance with detailed drawings to be submitted for approval. Devices and equipment for fire protection service shall be of an approved make and type listed by the Underwriters' Laboratories, Inc. or approved by the Factory Mutual System. In the publications referred to herein the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Contracting Officer. The work shall begin 5 feet outside of the building walls.
- B. Submittals Required: Partial submittals will not be accepted. Annotate descriptive data to show specific model, type, and size of each item the Contractor proposes to furnish. Prepare working drawings on sheets not smaller than 30 inches by 42 inches, in accordance with the requirements for "Working Drawings (Plans)" as specified in NFPA 13, and include data essential to the proper installation of each system. Do not commence work until the design of each system and the various components have been approved. The Contracting Officer will review and approve all submittals. Before any work is commenced, submit for approval complete sets of working drawings and calculations for each sprinkler system, hydraulic calculations to show the basis for the design, graphs, or tables showing the pressure-discharge relationship for the sprinkler heads; and full descriptive data for pipe, fittings, alarm valves, outside stem & yoke valves, check valves, water-motor alarms, sprinkler heads, hangers, pressure switches, devices, materials, and associated equipment.
 - C. Instruction Manuals: Furnish instruction manuals containing complete operation and maintenance instructions for the specific make and model of the alarm valve furnished. Place one copy of each instruction manual in a flexible oil resistant protective binder and mount in an accessible location on the vicinity of each alarm valve. Furnish three additional copies of each instruction manual.
 - D. As-Built (Record) Working Drawings: After completion, but before final acceptance of the work, furnish a complete set of drawings of each sprinkler system for record purposes. The drawings shall not be smaller than 30 inches by 42 inches reproducible drawings on mylar film with title block (8 inches by 4 inches) similar to full size contract drawings. Furnish the as-built (record) working drawings in addition to the as-built contract drawings required by Section 01021.

PART 2 - PRODUCTS

2.1 DESIGN OF SPRINKLER SYSTEMS: Wet pipe fire extinguishing systems shall provide a uniform distribution of water over the design area and shall conform to NFPA 13 and to the requirements specified herein. The wet pipe sprinkler systems shall be hydraulically designed in accordance with the requirements of NFPA 13.

- A. Sprinkler Heads: Heads shall have nominal 1/2" or 17/32" orifice. Release elements of each head shall be of the intermediate temperature rating or higher as suitable for the individual location where it is installed. Provide chromium plated ceiling plates and pendent sprinklers below suspended ceilings. Provide corrosion resistant sprinkler heads and sprinkler head guards as required by NFPA 13. Sprinkler heads shall be rated for 250 °F to 300 °F.
- B. Cabinet: Provide extra sprinkler heads and sprinkler head wrench in a metal cabinet adjacent to the alarm valve within each building. The number and types of extra sprinkler heads shall be as specified in NFPA 13.
- D. Alarm Valve: Valve shall be of the variable pressure type complete with all accessories and appurtenances necessary for the proper operation of each system and to prevent false alarms due to surges or other conditions in the supply to each system.
- E. Density of Application of Water: Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinklers shall be spaced in accordance with the hazard classifications as specified in NFPA 13 and on the project drawings. In addition an outside hose stream requirement of 250 gpm shall be provided.
- F. Sprinkler Discharge Area: Area shall be hydraulically most remote area as defined in NFPA 13 for hazard classification as specified on the project drawings.
- G. Friction Losses: Calculate losses in pipe in accordance with the Hazen - Williams formula with 'C' value of 120 for steel pipe, 150 for copper tube, and 140 for buried cement lined ductile iron pipe and asbestos cement pipe.
- H. Location of Sprinkler Heads: Heads in relation to the ceiling and the spacing of sprinkler heads shall not exceed that permitted by NFPA 13 for hazard occupancy as specified on the project drawings. The spacing of sprinklers on the branch lines shall be essentially uniform.
- I. Water Supply: Base hydraulic calculations on a static pressure of 125 pounds per square inch gauge (psig) with 2,500 gpm being available at the discharge of the primary and reserve pumps.

2.2 ALARMS:

- A. Water Motor Alarm: Provide alarms of the approved weatherproof and guarded type, to sound locally on the flow of water in each sprinkler system to which it is connected. Mount alarms on the outside of the outer walls of each building, at a location as directed.
- B. Pressure Switch: Provide switch with circuit opener or closer for the automatic transmittal of an alarm over the facility fire alarm system and connect into the fire alarm system.

Alarm actuating device shall be of the mechanical diaphragm controlled water pressure type with retard device. The retard device shall be adjustable from 10 to 60 seconds, and shall be of a type which instantly recycles when pressure is released on the diaphragm. The alarm tone shall be of a "pulsating" type.

2.3 ABOVE GROUND PIPING SYSTEMS: Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard tapered reducing pipe fittings; the use of bushings will not be permitted. Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or graphite and oil; apply only on male threads. Pipe nipples 6 inches long and shorter shall be Schedule 40 steel pipe. Run the piping concealed in areas with suspended ceilings.

- A. Sprinkler Pipe and Fittings: Sprinkler pipe and fittings shall be in accordance with NFPA 13 except that piping smaller than 2 inch shall be schedule 40. Water motor alarm drain piping shall be zinc coated steel pipe and fittings. Rubber gasketed grooved end pipe and fittings with mechanical couplings shall only be permitted in pipe sizes 2 inch and larger. Grooved mechanical fittings shall be ductile iron or malleable iron with grooved or shouldered designs to accept grooved end couplings. Use of segmentally welded steel fittings, restriction orifices, reducing flanges, and plain-end fittings with mechanical couplings (which utilizes steel gripping devices to bite into pipe when pressure is applied) will not be permitted. Grooved mechanical couplings shall be ductile or malleable iron housings, a synthetic rubber gasket of a central cavity pressure responsive t design, with nuts, bolts, locking pin, locking toggle or lugs to secure rolled grooved pipe and fittings. All coupling and fitting products shall be from a single approved manufacturer.
- B. Pipe Hangers (Supports): Provide in accordance with NFPA 13.
- C. Valves: Provide valves as required by NFPA 13 and of types approved for fire service.

1. Check Valves: Cast iron body with bolted top, horizontal swing with a bronze disc or cast iron disc ring and flanged ends, or grooved end, electro plated ductile iron body with dual disc design. U.L. listed to 250 psi, tapped for 1/2" ball drip.
 2. Gate valves: Flanged, outside screw and yoke type, open by counter-clockwise rotation, rated for at least a 175 psi working pressure.
 3. Butterfly valves: Grooved end or wafer style. 2-1/2 inch to 8 inch shall be listed to 175 psi with internal tamper switch. Body and disc shall be ductile iron.
 4. Ball Valves: 2 inch and smaller shall be threaded, forged brass construction, with teflon seats and blowout proof stem. UL/FM listed to 600 psi.
- D. Identification Signs: Attach properly lettered approved metal signs conforming to NFPA 13 to each valve and alarm device. Permanently affix design data nameplates to the riser of each system.
- E. Inspector's Test Connection: Provide test connections approximately 6 feet above the floor for each sprinkler system or portion of each sprinkler system equipped with an alarm device and locate at the hydraulically most remote part of each system. Test Connection shall be an integral UL/FM listed assembly incorporating a combination sight glass/orifice. Orifice to be same as sprinkler head orifice.
- F. Main Drains: Provide drain piping to discharge at safe points outside each building or to sight cones attached to drains of adequate size to readily receive the full flow from each drain under maximum pressure. Provide auxiliary drains as required by NFPA 13.
- G. Pipe Sleeves: Provide where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25-inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and caulk at both ends of the sleeve with plastic waterproof cement.
1. Sleeves in Masonry and Concrete Walls, Floors: Provide ASTM A 53 or ASTM A 120, Schedule 40 or Standard Weight, zinc coated steel pipe sleeves. Sleeves in floor slabs shall extend 3 inches above the finished floor.
 2. Sleeves in partitions, and Other Than Masonry and Concrete Walls, Floors, and Roofs: Provide zinc coated steel sheet having a nominal weight of not less than 0.90 pounds per square foot.

- H. Escutcheon Plates: Provide approved one piece of split hinge type plates for piping passing through floors, walls and ceilings in both exposed and concealed areas. Provide chromium plated metal plates where pipe passes through finished ceilings. Provide other plates of steel or cast iron with aluminum paint finish. Securely anchor plates in place with set screws or other approved positive means.
- I. Fire Department Inlet Connections: Provide inlet connections approximately 3 feet above grade, of the approved two way type with 2.5-inch National Standard female hose threads with plug and chain.

2.4 BURIED PIPING SYSTEMS:

- A. Pipe and Fittings: Provide outside coated cement lined ductile iron pipe and fittings conforming to NFPA 24 for piping less than 5 feet outside of the building walls. Anchor the joints in accordance with NFPA 24 using pipe clamps and steel rods. Minimum depth of cover shall be 3 feet. Piping more than 5 feet outside of the building walls shall be provided under Section 02713, "Water Distribution System."
 - 1. Polyethylene for pipe encasement shall be in tube or sheet form, minimum nominal thickness of 0.008 inches, conforming to ANSI/AWWA C105.

PART 3 - EXECUTION

- 3.1 CONNECTIONS TO WATER SUPPLY SYSTEMS: Connections shall be to the new Fire Pump System.
- 3.2 CORROSION PROTECTION: All underground ductile iron pipe, valves, and fittings shall be encased in a polyethylene film in accordance with ANSI/AWWA Specification C105.
- 3.3 DISINFECTION: Disinfect new water piping in accordance with AWWA C601. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for a minimum of 24 hours. Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 parts per million.
- 3.4 FIELD PAINTING: Clean, pre-treat, prime, and paint new sprinkler system including valves, piping, conduit, hangers, miscellaneous metalwork, and accessories. Apply coatings to clean dry surfaces using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat of Mil. Spec. DOD-P-15328 pre-treatment primer applied to a minimum dry film thickness of 0.3 mil, and one coat of Fed. Spec. TT-P-645 primer applied to a minimum dry film thickness of one mil. Exercise care to avoid the painting of sprinkler heads or protective devices. Remove materials which are used to protect sprinkler heads, while painting is in process, upon the completion of painting. Remove sprinkler heads which are painted and provide new clean sprinkler heads of the proper type. Provide primed surfaces with the following:

- A. Sprinkler Systems in Unfinished Areas: Unfinished areas are defined as attic spaces, spaces above suspended ceiling, crawl spaces, pipe chases, and spaces where walls or ceiling are not painted or not constructed of a pre-finished material. Provide primed surfaces with one coat of Fed. Spec. TT-E-489 red enamel applied to a minimum dry film thickness of one mil.
- B. Sprinkler Systems in All Other Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of Fed. Spec. TT-E-489 red enamel applied to a minimum dry film thickness of one mil. Provide piping with 2-inch wide red enamel or self adhering red plastic tape bands spaced at maximum of 20-foot intervals throughout the piping systems, except in finished areas such as offices the red bands may be deleted.

3.5 ELECTRICAL WORK: Coordinate with other trades, all electrical connections as required by system installation. Furnish all electrical connections as required to provide complete working system.

3.6 FIELD TESTING AND FLUSHING:

- A. Preliminary Tests: Hydrostatically test each system at 200 psig for a period of 2 hours. Flush piping in accordance with NFPA 13. Piping above suspended ceilings shall be tested, inspected and approved before installation of ceilings. Test the alarms and other devices. Test the water flow alarms by flowing water through the inspector's test connection. When tests have been completed and corrections made, submit a signed and dated certificate, similar to that specified in NFPA 13, with a request for a formal inspection and tests.
- B. Formal Inspection and Tests: Contracting Officer, or Contracting Officer's representative will witness formal tests and approve all systems before they are accepted. Submit the request for formal inspection at least 15 days prior to the date the inspection is to take place. An experienced technician regularly employed by the sprinkler installer shall be present during the inspection. At this inspection, repeat any or all of the required tests as directed. Correct defects in the work provided by the Contractor, and make additional tests until it has been demonstrated that the systems comply with all contract requirements. Everything required for testing shall be provided by the Contractor and all expenses, in connection with the tests, shall be defrayed by him.

SECTION 15330 - AFFF FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Provide a automatic aqueous film forming foam (AFFF) Fire Extinguishing System (Hangar maintenance area pre-action AFFF system, aircraft underfuselage and underwing oscillating monitor nozzles, and manually operated foam/water hose line stations) as specified herein and indicated on drawings.

1.2 RELATED WORK AND APPLICABLE REQUIREMENTS SPECIFIED ELSEWHERE

- A. DIVISION 1 - GENERAL REQUIREMENTS: These shall apply to all work included in this section.
- B. Related Work:
1. DIVISION 3 - CONCRETE
 2. DIVISION 15 - MECHANICAL
 3. DIVISION 16 - ELECTRICAL
 4. Section 15325 - Wet Pipe Sprinkler Systems
 5. Section 15335 - Fire Pump Systems
 6. Section 15340 - Fire Detection, Alarm and Equipment Activation Systems

1.3 APPLICABLE PUBLICATIONS: The publications listed below form a part to this specification to the extent referenced. The publications are referred to in the text by basic designation only.

A. Federal Specifications (Fed. Spec.):

TT-E-489F Enamel, Alkyd, Gloss (For Exterior and
& AM 1 Interior Surface)

TT-P-645A Primer, Paint, Zinc Chromate, Alkyd type

B. Military Specification (Mil. Spec.):

DOD-P-15328D Primer (Wash), Pre-Treatment (Formula No. 117 for Metals)
(Metric)

C. American Society for Testing and Materials (ASTM) Publications:

A 53-80 Pipe, Steel, Black and Hot Dipped Zinc Coated (Galvanized)
Welded and Seamless for Ordinary Uses

A 120-80 Pipe, Steel, Black and Hot Dipped Zinc Coated (Galvanized)
Welded and Seamless for Ordinary Uses

D. American Water Works Association (AWWA) Publications:

C601-68 Disinfecting Water Mains.

E. Factory Mutual System (FM) Publications

1995 Approval Guide

F. National Fire Protection Association (NFPA) Publications:

11-94 Installation for Low Expansion Foam and Combined Agent Systems.

13-93 Sprinkler Systems

14-93 Installation of Standpipe and Hose Systems

16-91 Installation of Foam-Water Sprinkler Systems and Foam-Water Spray
Systems

16A-94 Closed-Head Foam-Water Sprinkler Systems

409-90 Aircraft Hangars

30-93 Flammable and Combustible Liquids Codes

G. Underwriters' Laboratories, Inc. (UL) Publications:

1995 Fire Protection Equipment Listing

H. Department of the Air Force:

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ANGRC/CEE and ANG/CEE review comments

- 1.4 QUALIFICATIONS OF INSTALLER: Prior to installation, submit data for approval by the Contracting Officer, showing that the Contractor has successfully installed automatic fire extinguishing sprinkler systems of the same type and design as specified herein. The data shall include the names and locations of at least two installations where the contractor has installed such systems. The Contractor shall indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a

period of not less than 18 months. The design and installation of the wet pipe sprinkler systems shall be coordinated with the systems being furnished and constructed **under SECTIONS: WET PIPE SPRINKLER SYSTEM, FIRE PUMPS and LIFE SAFETY & ALARM SYSTEM.** All the work covered by these sections shall be the responsibility of one fire protection firm. This firm shall normally be engaged in the field of fire protection with a registered fire protection engineer on staff. Certification of this qualification shall be submitted for approval.

1.5 GENERAL REQUIREMENTS: DIVISION 1, "General Requirements", applies to this section, with the additions and modifications specified herein.

- A. Description of Work: The work includes designing and providing new automatic aqueous film forming foam (AFFF) fire extinguishing system, which incorporates Hangar maintenance area pre-action AFFF system, AFFF oscillating monitors for underwing and underfuselage fire protection, and AFFF/Water Hand Hose Line Stations as shown schematically on the project drawings. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 13, NFPA 16 and NFPA 409, except as modified herein. Systems shall include all materials, accessories and equipment necessary to provide each system complete and ready for use. Design and install each system to give full consideration to blind spaces, piping, electrical equipment, ductwork, and all other construction and equipment to afford complete coverage in accordance with detailed drawings to be submitted for approval. Devices and equipment for fire protection service shall be of an approved make and type listed by the Underwriters' Laboratories, Inc. or approved by the Factory Mutual System. In the publications referred to herein the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Contracting Officer. The work shall begin where the fire pump discharge piping connects to the AFFF System header.
- B. Submittals Required: Partial submittals will not be accepted. Annotate descriptive data to show specific model, type, and size of each item the Contractor proposes to furnish. Prepare working drawings on sheets not smaller than 30 inches by 42 inches, in accordance with the requirements for "Working Drawings (Plans)" as specified in NFPA 16, and include data essential to the proper installation of each system. Do not commence work until the design of each system and the various components have been approved. The Contracting Officer will review and approve all submittals. Before any work is commenced, submit for approval complete sets of working drawings and calculations for each

AFFF system, hydraulic calculations to show the basis for the design, graphs, or tables showing the pressure-discharge relationship for the system; and full descriptive data for pipe, fittings, deluge valves, outside stem & yoke valves, check valves, header, oscillating nozzles, AFFF diaphragm pressure tank, hose stations, ultra violet/infra red detectors, switches, control panel for detection devices, batteries and charger alarms, electrical wiring diagrams, hangers, pressure switches, devices, materials, and all associated equipment.

- C. Instruction Manuals: Furnish instruction manuals containing complete operation and maintenance instructions for the specific make and model of the alarm valve furnished. Place one copy of each instruction manual in a flexible oil resistant protective binder and mount in an accessible location on the vicinity of each control valve. Furnish three additional copies of each instruction manual.
- D. As-Built (Record) Working Drawings: After completion, but before final acceptance of the work, furnish a complete set of drawings of each AFFF system for record purposes. The drawings shall not be smaller than 30 inches by 42 inches reproducible drawings on mylar film with title block (8 inches by 4 inches) similar to full size contract drawings. Furnish the as-built (record) working drawings in addition to the as-built contract drawings required by Section 01021.

PART 2 - PRODUCTS

2.1 DESIGN OF HANGAR MAINTENANCE AREA PRE-ACTION FOAM SYSTEM: AFFF Pre-action fire extinguishing systems shall provide a uniform distribution of water over the design area and shall conform to NFPA 13, NFPA 16A and to the requirements specified herein. The wet pipe sprinkler systems shall be hydraulically designed in accordance with the requirements of NFPA 16A.

- A. Remote Flow Control Valves: The remote flow control valves (Viking Flow Control Valve Model H-1 or equivalent) , which shall be located in each AFFF foam/water pre-action system riser shall be activated as follows:
 - 1. By activation of any two cross-zoned heat detectors installed at ceiling level.
 - 2. By manual controls provided at each overhead AFFF pre-action sprinkler system deluge valve.

Further, each AFFF pre-action system riser flow control valve shall be provided with local ON/OFF Controls for operation of that pre-action system. If valves and piping are not the same size, provide smoothly tapered connections. Provide gauges and other appurtenances at the flow control valves. Provide a test detection device for each actuation circuit adjacent to each valve which the device controls, as required by NFPA

13. Install O.S. & Y. gate valve upstream from each remote flow control valve. In addition, both AFFF pre-action system riser control valves shall be operable OPEN and CLOSE, by means of a remote ABORT Stations located on the project drawings. As also stated in Section 2.2.A of this Specification, these ABORT Stations shall also operate the AFFF oscillating monitor nozzle station flow control valves.

- B. Sprinkler Heads: Heads shall have nominal 1/2" or 17/32" orifice. Release elements of each head shall be rated between 250 °F and 300 °F.
- C. Cabinet: Provide extra sprinkler heads and sprinkler head wrench in a metal cabinet adjacent to the pre-action valve within each building. The number and types of extra sprinkler heads shall be as specified in NFPA 16A.
- D. Alarm Valve: Valve shall be of the non-latching flow control type pre-action (deluge) type complete with all accessories and appurtenances necessary for the proper operation of each system and to prevent false alarms due to surges or other conditions in the supply to each system. These valves shall be of the type which can be reset without removal of cover or face plate of the valve. These shall trip only upon activation by the detection system. These systems shall have a rubber faced check valve in them above the deluge valve for maintaining supervisory air pressure within the piping system. The air pressure shall be limited to 10 psig.
- E. Density of Application of Water: Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinklers shall be 0.16 gallons per minute (gpm) per square foot of application surface with outside hose stream requirement of 250 gpm. Delivered densities will be uniform over the "remote design area" between 100% and 115% of the design density.
- F. Sprinkler Discharge Area: Area shall be most hydraulically remote 18,000 square feet.
- G. Overhead systems shall be equally divided such that each riser covers an equal floor area. The maximum limit of any single system shall be 15,000 square feet. Division of the systems should take advantage of existing structural/framing features for the installation of the draft curtains around each system. Two systems shall be provided.
- H. Test headers will be provided on all closed head AFFF systems. Header will connect all risers and terminate on the Hangar floor in an appropriate number of 2.5 inch valved connections. Header will be sized to flow midrange of the individual proportioner(s) demand.

- I. Basket type strainers shall be provided on the main water supplies supporting the system and all control lines in addition to locations required by NFPA standards.
- J. AFFF 3 Percent Liquid Concentrate Supply System: The system shall have a horizontal diaphragm bladder tank, proportioners, foam control valves, controls, and accessories as indicated on the drawings and as required by NFPA 16 for an operable system. Two 900 gallon capacity tanks, manifolded together, shall be provided.
- K. Friction Losses: Calculate losses in pipe in accordance with the Hazen - Williams formula with 'C' value of 100 for steel pipe, 150 for copper tube, and 140 for buried cement lined ductile iron pipe and asbestos cement pipe.
- L. Location of Sprinkler Heads: Heads in relation to the ceiling and the spacing of sprinkler heads shall not exceed that permitted by NFPA 13 for extra hazard occupancy. The spacing of sprinklers on the branch lines shall be essentially uniform.
- M. Water Supply: Base hydraulic calculations on 5,000 gpm being available at a pressure of 125 psig at the discharge flange of the fire pump(s) system.

2.2 DESIGN OF AFFF UNDERWING MONITOR FOAM SYSTEM: Design of the AFFF fire extinguishing system shall be by hydraulic calculations for uniform distribution of water -foam solution over the design area and shall conform to NFPA 16, NFPA 409, and to the requirements as specified herein.

- A. Remote Flow Control Valves: The remote flow control valves (Viking Flow Control Valve Model H-1 or equivalent) , which shall be located adjacent to each foam/water oscillating monitor nozzle shall be simultaneously activated as follows:
 - 1. By activation of any two cross-zoned heat detectors installed at ceiling level.
 - 2. By manual controls provided at each overhead AFFF pre-action sprinkler system riser flow control valve.
 - 3. By AFFF oscillating monitor nozzle stations installed as indicated on the project drawings.
 - 4. By remote manual ABORT Stations, which can both OPEN and CLOSE the flow control valves, installed as indicated on the project drawings. AS stated in Section 2.1.A of this Specification, these remote manual ABORT Stations also operate the AFFF pre-action sprinkler system riser flow control valves.

Further, each AFFF oscillating monitor nozzle station flow control valve shall be provided with local ON/OFF Controls for operation of that monitor station. Also, each AFFF oscillating monitor nozzle station shall be provided with local manual controls for the ON/OFF operation on all AFFF oscillating monitor nozzle stations. If valves and piping are not the same size, provide smoothly tapered connections. Provide gauges and other appurtenances at the flow control valves. Provide a test detection device for each actuation circuit adjacent to each valve which the device controls, as required by NFPA 13. Install remote manual releases for the oscillating monitor flow control valve where indicated on the drawings. Install O.S. & Y. gate valve upstream from each remote flow control valve.

- B. Oscillating Monitors: The oscillating AFFF solution monitors shall be water motor powered and each shall discharge at a minimum design rate of 500 gpm of foam solution each, based upon a 100 psig residual pressure at the monitor inlet connection. The AFFF oscillating monitor nozzles shall be nominally installed to provide a discharge at a rate of 0.10 gallons per minute (gpm) per square foot of AFFF solution over the specified degrees of arc with a minimum projection distance of 95 feet. As shown by the project drawings, a total of three (3) AFFF oscillating monitor nozzle stations shall be provided.
- C. Friction Losses: Calculate losses in pipe in accordance with the Hazen-Williams Formula with 'C' value of 100 for steel pipe and 140 for cement lined ductile iron pipe.
- D. Water supply: Base hydraulic calculations on the capacity of the fire pump as specified in Section 15380 "Fire Pumps" and as indicated on the drawings.
- E. AFFF 3 Percent Liquid Concentrate Supply System: The system shall have a diaphragm bladder tank, proportioners, foam control valves, controls, and accessories as indicated on the drawings and as required by NFPA 16 for an operable system. Two 900 gallon capacity tanks, manifolded together, shall be provided.
- F. Foam/Water Hand Hose Stations: The minimum supply of foam-liquid concentrate shall be sufficient to provide operations of at least two hand hose lines for a period of twenty minutes at a minimum foam solution discharge rate of 60 gpm each. A total of three (3) AFFF Foam/Water Hand Hose Line Stations, located as indicated on the project drawings, shall be provided. The system shall conform with the applicable portions of NFPA 14, and NFPA 11.
- G. Water Supply: Base hydraulic calculations on 5,000 gpm being available at a pressure of 125 psig at the discharge flange of the fire pump(s) system.

2.3 DETECTION SYSTEMS: Detection system shall be ultra violet/infra red detectors and ceiling level heat detectors. The connecting wiring shall be supervised. Install wiring in protective metal conduit.

- A. Detectors: Ultraviolet/Infrared (UV/IR) detectors and ceiling level heat detectors shall be located in the areas indicated on the project drawings. As shown, a minimum of five (5) UV/IR detectors shall be provided. Detectors are specified in Section 15340 "Fire Detection, Alarm and Equipment Activation." The UV/IR detectors are for alarm purposes only.
- B. Control Panel and Accessories, wiring switches, supervision, related items and installation shall be provided as specified in Section 15340, "Fire Detection, Alarm and Equipment Activation."

2.4 ALARMS: All electrical alarms, wiring, controls, accessories, and their installation are specified in Section 15340 "Fire Detection, Alarm and Equipment Activation."

- A. Local Alarm: Provide electric alarm bell to sound locally on operation of any detection system, regardless of whether water flows or not.
- B. Fire Alarm: Provide equipment for the automatic transmittal of all alarms.
- C. Trouble Alarm: Provide electric alarm to indicate trouble or failure of the detection system.
- D. All alarm tones shall comply with Reference 1.3.H of this specification..

2.5 ABOVE GROUND PIPING SYSTEMS: Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard tapered reducing pipe fittings; the use of bushings will not be permitted. Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or graphite and oil; apply only on male threads.

- A. Sprinkler Pipe and Fittings: Sprinkler pipe and fittings shall be in accordance with NFPA 13 except that piping smaller than 2 inch shall be schedule 40. Water motor alarm drain piping shall be zinc coated pipe and fittings. Rubber gasketed grooved end pipe and fittings with mechanical couplings shall only be permitted in pipe sizes 2 inch and larger. Grooved mechanical fittings shall be ductile iron or malleable iron with grooved or shouldered designs to accept grooved end couplings. Use of segmentally welded steel fittings, restriction orifices, reducing flanges, and plain-end fittings with mechanical couplings (which utilizes steel gripping devices to bite into pipe when pressure is applied) will not be permitted. Grooved mechanical couplings shall be ductile or malleable iron housings, a synthetic rubber gasket of a central cavity pressure responsive to design, with nuts, bolts, locking pin, locking toggle or lugs to secure

rolled grooved pipe and fittings. All coupling and fitting products shall be from a single approved manufacturer.

- B. Pipe Hangers (Supports): Provide in accordance with NFPA 16.
- C. Valves: Provide valves as required by NFPA 16 and of types approved for fire service.
 - 1. Check Valves: Cast iron body with bolted top, horizontal swing with a bronze disc or cast iron disc ring and flanged ends, or grooved end, electro plated ductile iron body with dual disc design. U.L. listed to 250 psi, tapped for 1/2" ball drip.
 - 2. Gate Valves: Flanged, outside screw and yoke type, open by counter-clockwise rotation, rated for at least a 175 psi working pressure.
 - 3. Butterfly Valves: Grooved end or wafer style. 22-1/2 inch to 8 inch shall be listed to 175 psi with internal tamper switch. Body and disc shall be ductile iron.
 - 4. Ball Valves: 2 inch and smaller shall be threaded, forged brass construction, with teflon seats and blowout proof stem. UL/FM listed to 600 psi.
- D. Identification Signs: Attach properly lettered approved metal signs conforming to NFPA 16 to each valve and alarm device. Permanently affix design data nameplates to the riser of each system.
- E. Main Drains: Provide drain piping to discharge at safe points outside each building or to sight cones attached to drains of adequate size to readily receive the full flow from each drain under maximum pressure. Provide auxiliary drains as required by NFPA 13.
- F. Pipe Sleeves: Provide where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25-inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and caulk at both ends of the sleeve with plastic waterproof cement.
 - 1. Sleeves in Masonry and Concrete Walls, Floors: Provide ASTM A 53 or ASTM A 120, Schedule 40 or Standard Weight, zinc coated steel pipe sleeves. Sleeves in floor slabs shall extend 3 inches above the finished floor.
 - 2. Sleeves in partitions, and Other Than Masonry and Concrete Walls, Floors, and Roofs: Provide zinc coated steel sheet having a nominal weight of not less than 0.90 pounds per square foot.

- G. Escutcheon Plates: Provide approved one piece of split hinge type plates for piping passing through floors, walls and ceilings in both exposed and concealed areas. Provide chromium plated metal plates where pipe passes through finished ceilings. Provide other plates of steel or cast iron with aluminum paint finish. Securely anchor plates in place with set screws or other approved positive means.

2.6 AQUEOUS FILM FORMING FOAM (AFFF) SYSTEM: All materials and equipment comprising the AFFF System shall be designed and installed in accordance with NFPA 16.

- A. AFFF Diaphragm Liquid Concentrate Storage Tank: Tank shall be a horizontal pressure vessel with a full diaphragm within the vessel and shaped to conform to the inner pressure vessel configuration. Diaphragm foam storage tank is to be of an approved type. The foam concentrate is to be stored within the diaphragm so that none of the foam concentrate is in contact with the steel tank. Foam tank is to be constructed of steel material capable of 175 psi working pressure, factory tested for two (2) hours at a minimum of 250 psi. Diaphragm is to be constructed of BUNA-N with nylon reinforcement. The diaphragm is to be sized so that no stretching or excess travel within the tank occurs. Diaphragm foam tank is to be complete with all necessary outlets and mounting supports, such as saddles or cradles with provisions for leveling adjustments. Diaphragm foam tank trim shall include fill cup, ball calves, and sight gauge to enable complete isolation of the foam tank from the system, during the filling or draining of the foam tank. Two tanks of 900 gallons each, manifolded together, shall be provided (see paragraph 2.2.E of this specification).
- B. Oscillating Monitors: Monitors shall permit an oscillating arc adjustable from 0 degree to 200 degrees. Oscillating speed shall be adjustable with a decontrol lever to permit both manual elevation and rotation. The oscillating power shall be obtained from the foam solution supplied to the monitor for fire suppression. The throw angle shall be adjustable from minus 50 degrees to plus 90 degrees. Monitors shall be supplied with a short barrel, adjustable pattern, non-aspirating type nozzle.
- C. AFFF Concentrate Piping: All pipe and fittings containing AFFF concentrate shall be stainless steel (304 or 316) schedule 40 pipe. All piping and fittings shall be joined by welding or flanged connections only. No screwed pipe or fittings shall be permitted.
- D. AFFF Shut-off Valves: These valves shall be ball-type, stainless steel (304 or 316) body and trim, teflon seated. Operating handle shall be provided such that the valve can be sealed with handle parallel to pipe in open position. Seals, lead and wire metal strip, shall be installed on ball valves after systems are installed and approved. Strainers and check valves shall be stainless steel (304 or 316), suitable for use with AFFF concentrate.

- E. Proportioners: The foam proportioners are to be modified Venturi type used to introduce a metered drop in the system supply piping. Mixing of the foam concentrate and water shall occur at the low pressure throat section of the proportioner. A fixed percentage 3% metering orifice shall be installed in the foam line at the foam concentrate outlet. The proportioner for B-1 Fuel Systems Maintenance Hangar shall be capable of providing a 3% proportioning of the AFFF concentrate for the minimum and maximum flow required.
- F. Foam/Water Hand Hose Stations: Stations shall be of the type consisting of a stationary foam-liquid concentrate diaphragm lined steel tank fitted with listed proportioning devices, a minimum of 75 feet of 1 1/2 inch discharge hose on a reel, and other equipment necessary to provide a complete and operational system. Each hand hose shall be fitted with a control valve and a nozzle designed to permit foam application or water spray. Nozzles shall be of the shutoff type or shall have a shutoff valve at the nozzle inlet.
- G. AFFF: The AFFF liquid concentrate shall be the 3 percent type UL listed or FM approved. No mixing of two different manufacturer's products will be permitted. The Contractor shall supply sufficient AFFF liquid concentrate to fill the storage tank and foam piping system and to perform all system testing.

PART 3 - EXECUTION

- 3.1 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS: Connections shall be shall be to the new Fire Pump System.
- 3.2 DISINFECTION: Disinfect new water piping in accordance with AWWA C601. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for a minimum of 24 hours. Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 parts per million.
- 3.3 FIELD PAINTING: Clean, pre-treat, prime, and paint new AFFF system including valves, piping, conduit, hangers, miscellaneous metalwork, and accessories. Apply coatings to clean dry surfaces using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat of Mil. Spec. DOD-P-15328 pre-treatment primer applied to a minimum dry film thickness of 0.3 mil, and one coat of Fed. Spec. TT-P-645 primer applied to a minimum dry film thickness of one mil. Exercise care to avoid the painting of protective devices. Remove materials which are used to protect devices, while painting is in process, upon the completion of painting. Remove protective devices which are painted and provide new clean discharge devices of the proper type. Provide primed surfaces with two coats of Fed. Spec. TT-E-489 red enamel applied to a minimum dry thickness of one mil.
- 3.4 ELECTRICAL WORK: Electrical work is specified in Section 16050, "Basic Materials and Methods, Electrical."

3.5 FIELD TESTING AND FLUSHING:

- A. Preliminary Tests: Hydrostatically test each system at 200 psig or 50 percent above the design pressure, whichever is greater, for a period of 2 hours. Flush piping in accordance with NFPA 13. Test the alarms and other devices. Test the water flow alarms by flowing water through the inspector's test connection. The deluge valves, foam control valves, foam proportioners, oscillating monitors, AFFF tank and other AFFF system elements shall be tested as required by NFPA 16 and NFPA 409. The AFFF system elements shall be subject to flow test with water only from oscillating monitors to determine if flow pressure, operating characteristics and discharge pattern are satisfactory. The test will be repeated with foam to determine if foam agent discharges base, foam quality, discharge pattern, and operating characteristics are satisfactory. The latter test should be limited to the extent of time required to assess applied foam quality. When test have been completed and all corrections made, submit a signed and dated certificate, similar to that specified in NFPA 16, with a request for formal inspection and test.
- B. Formal Inspection and Tests: NGB/DEE Representative and the Contracting Officer will witness formal tests and approve all systems before they are accepted. Submit the request for formal inspection at least 15 days prior to the date the inspection is to take place. An experienced technician regularly employed by the fire protection contractor shall be present during the inspection. At this inspection, repeat any or all of the required tests as directed. Test each detection device and its connection to each valve by the application of heat or flame as applicable. Test each deluge system by full flow from individual systems to any combination of systems. Correct defects in the work provided by the Contractor, and make additional tests until it has been demonstrated that the systems comply with all contract requirements. Everything required for testing shall be provided by the Contractor and all expenses, in connection with the tests, shall be defrayed by him.

SECTION 15335 - FIRE PUMP SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Providing automatic starting electric motor driven vertical shaft turbine type fire pump, diesel engine vertical shaft turbine type pump and all related work as indicated on drawings and specified herein.

1.2 RELATED WORK AND APPLICABLE REQUIREMENTS SPECIFIED ELSEWHERE

- A. DIVISION 1 - GENERAL REQUIREMENTS: These shall apply to all work included in the section.
- B. Related Work:
 - 1. Section 02713 - Water Distribution System
 - 2. DIVISION 3 - Concrete
 - 3. Section 15325 - Wet Pipe Sprinkler Systems
 - 4. Section 15330 - AFFF Fire Suppression Systems
 - 5. Section 15340 - Fire Detection, Alarm and Equipment Activation Systems

1.3 APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to hereinafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

- A. American National Standards Institute (ANSI) Publications:

B16.1-75	Cast Iron Flange and Flanged Fittings
B16.5-77	Steel Pipe Flanges and Flanged Fittings
B16.9-78	Factory-Made Wrought Steel Buttwelding Fittings
B31.1-80	Power Piping

- B. American Society for Testing and Materials (ASTM) Publications:

A47-77	Malleable Iron Castings
A53-80	Welded and Seamless Steel Pipe
A120-80	Pipe, Steel, Black and Hot Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
A536-77	Ductile Iron Castings

- C. American Water Works Association (AWWA) Publications:

D. Factory Mutual System (FM) Publications:

1995 Approval Guide

E. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publications:

SP-58-75 Pipe Hangers and Supports - Materials, Design, and Manufacture

SP-69-76 Pipe Hangers and Supports - Selection and Application

F. National Fire Protection Association (NFPA) Publications:

20-93 Centrifugal Fire Pumps

G. Underwriters' Laboratories, Inc. (UL) Publications:

1995 Fire Protection Equipment Lists

1.4 **QUALIFICATIONS OF INSTALLER:** Prior to installation, the Contractor shall submit data for the approval of the Contracting Officer which will show that he has successfully installed fire pumps and associated equipment of the same type and design as specified herein. The data shall include the name and locations of at least two installations where the Contractor has installed such systems. The Contractor shall indicate the type and design of these systems and certify that these systems have performed satisfactorily in the manner intended for a period of not less than 18 months. The design and installation of the fire pump system shall be coordinated with the systems being furnished and constructed under **SECTIONS: WET PIPE SPRINKLER SYSTEM, AFFF FIRE SUPPRESSION SYSTEMS, and FIRE DETECTION, ALARM AND EQUIPMENT ACTIVATION SYSTEMS.** All the work covered by these sections shall be the responsibility of one fire protection firm. This firm shall normally be engaged in the field of fire protection with a registered fire protection engineer on staff. Certification of this qualification shall be submitted for approval.

1.5 **GENERAL REQUIREMENTS:** DIVISION 1, General Requirements, applies to this section, with the additions and modifications specified herein.

A. **Description of Work:** The work includes providing automatic electric motor driven vertical turbine type fire pumps, automatic diesel engine driven vertical turbine type reserve fire pump, electric motor driven fire main pressure maintenance jockey pump, associated accessories and related work. Pump capacities at rated head shall be 2,500 gpm at discharge pressure of 125 psig. The pumps shall be installed so that automatic backup will be provided, i.e.,

if one or more of the designated PRIMARY FIRE PUMPS will not respond or will not provide the required flow and pressure to the fire area of concern, then the RESERVE FIRE PUMP will automatically start on low fire main pressure and provide the required additional pumping capacity. System shall be complete and ready for operation. Equipment, materials, installation and workmanship shall be in accordance with NFPA 20, except as specified otherwise. Devices and equipment for fire protection service shall be of a make and type listed by Underwriters' Laboratories, Inc. or approved by the Factory Mutual System. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Contracting Officer's Representative. The work shall begin at the OS&Y valve on the pump suction line and end at the OS&Y valve on the pump discharge line. The test header Siamese, by-pass and valves are also included.

- B. Submittals Required: The submittal requirements of DIVISION 1, "General Requirements," applies to this section. Before any work is commenced, submit complete sets of working drawings of each pump installation; full descriptive data for pumps, drivers, controller, pipe, fittings, OS&Y valves, check valves, relief valves, gauges and hose valve manifold test headers; manufacturers' certified pump discharge curves; complete circuit diagrams; interior wiring diagrams of controller; hangers; devices; materials; and associated equipment to the Contracting Officer for approval. The Contracting Officer will review and approve all submittals. Partial submittals will not be acceptable. Annotate descriptive data to show the specific model, type and size of each item the Contractor proposes to furnish. Prepare working drawings on sheets not smaller than 30 by 42 inches in accordance with the requirements for "Complete Plans and Data" as specified therein. No work shall begin until the design of the system and various components have been approved by the Contracting Officer.
- C. Instruction Manuals: Furnish instruction manuals containing complete instructions for the specific make and model of each pump, driver, controller, and associated equipment furnished. Place one copy of each instruction manual in a flexible oil resistant protective binder and mount in an accessible location near the pump. Furnish three additional copies of each instruction manual to the Contracting Officer.
- D. As-Built Working Drawings: Upon completion, and before final acceptance of the work, furnish to the Contracting Officer a complete set of as-built working drawings of each fire pump installation for record purposes. The as-built working drawings shall be not smaller than 30 and 42 inches reproducible drawings on mylar film with title block (8 by 4 inches) similar to full size contract drawings. The as-built working drawings shall be furnished in addition to the as-built contract drawings.
- E. Welder's Qualifications: Submit certifications on each welder's qualifications.

1.6 SEQUENCE OF OPERATION:

A. The PRIMARY FIRE PUMPS shall start as follows:

1. Automatically by signals from any two (2) cross-zoned rate-compensated heat detectors in Hangar Service Area AFFF Overhead Sprinkler System.
2. By operation of any one of the five (5) Local Manual AFFF system release station for the AFFF Monitor System in the Hangar Service Area.
3. Automatically by fire main pressure on the pump discharge side of 100 psig or less on the discharge of the fire pump system.
4. By remote manual START/ON push buttons located on the local fire pump control panel and/or the Central Fire Control/Monitoring Panel.

The PRIMARY FIRE PUMPS shall run until manually shutdown by the STOP/OFF push button control located on the Local Fire Pump Panel.

B. The RESERVE FIRE PUMP shall start as follows:

1. Automatically by fire main pressure on the pump discharge side of 75 psig or less on the discharge side of the fire pump system.
2. Automatically 10 seconds after failure of the one of the PRIMARY FIRE PUMPS to start.
3. By remote manual START/ON push buttons located on the Local Fire Pump Panel and/or the Central Fire Control/Monitoring Panel.

The RESERVE FIRE PUMP shall run until manually shutdown by the STOP/OFF push buttons located on the Local Fire Pump Panel.

(NOTE: Fire Pump STOP/OFF push buttons shall only be located on the Local Fire Pump Panels.)

The remote flow control valves (Viking Flow Control Valve Model H-1, or equivalent), which shall be located in each AFFF pre-action system riser and adjacent to each foam/water monitor nozzle, and which shall be used for control of water from the PRIMARY AND RESERVE PUMPS, shall open automatically by signals from any two (2) cross-zoned heat detectors, or from the operation of a foam/water monitor manual release station, thereby allowing a start of foam solution to all monitor nozzles.

The fire main pressure maintenance jockey pump shall be set to automatically start when the fire main pressure on the fire pump discharge side falls below 110 psig, and automatically shut off when the fire main pressure on the fire pump discharge side exceeds 120 psig. The jockey pump shall also be interlocked with the fire pump(s) for automatic shutdown whenever either, both or all, of the fire pumps are running. Upon manual shutdown of the fire pump(s) at the Local Fire Pump Panels, all remote AFFF pre-action riser and monitor nozzle flow control valves shall automatically close.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS:

- A. Fire Pumps: The PRIMARY and RESERVE fire pumps shall be vertical shaft turbine type pumps designed for fresh water service. The PRIMARY fire pumps shall be electric motor driven. The RESERVE fire pump shall be a diesel engine vertical shaft turbine type pump designed for fire service. Each pump assembly including associated equipment and appurtenances shall conform to NFPA 20, and shall be listed for fire protection service by Underwriters' Laboratories, Inc., or approved by the Factory mutual Laboratories.
1. The vertical shaft turbine pumps shall have the following:
 - a. Shut off head shall not exceed 140 percent of the total rated head. Each pump shall furnish not less than 150 percent of rated capacity at a total head of not less than 65 percent of total rated head.
 - b. Discharge flange, ANSI Class 250 bolt pattern
 - c. The column pipe and line shaft sections shall not exceed 10'-0" lengths. The column pipe shall have flanged connections. Bolting shall be provided with 316 stainless steel hex head machined bolts. Studs are not acceptable. The line shaft shall have threaded ends and be connected by threaded couplings.
 - d. A corrosion resistant basket-type strainer shall be attached to the suction manifold of the pump..
 - e. The pump manufacturer shall ensure that available NPSH exceeds the required pump NPSH for pump operation from 0 to 150 percent of rated flow capacity. The pump shall be designed for the following conditions:
 1. Pump base to bottom of intake basin.
 2. Pump base to lowest water level.
 - f. Materials of construction shall be compatible with a fresh water supply.
 - f. The firewater pump shall have a 316 stainless steel nameplate, with performance data stamped in 3/16 minimum letter height.

- D. Diesel Engine Driver: Engine shall be UL listed for fire protection service, complete with all necessary components for an operable system. Horsepower shall be not less than pump horsepower requirements at all points on the pump operating curve. Engine shall be equipped with a thermostatically-controlled water jacket warmer.
1. A fuel injection system consisting of a mechanical transfer pump and unit type injector shall be provided. Fuel injection shall be positive action and constant stroke activated by a cam shaft driven by gears from the engine crankshaft. The system shall include a fuel filter.
 2. The engine shall be provided with the following accessories:
 - a. A governor capable of regulating the engine speed within a range of 10 percent between shutoff and the maximum load conditions of the pump. The governor shall be field adjustable, set and secured to maintain rated pump speed at maximum pump load.
 - b. An overspeed shutdown device arranged to shut down the engine at a speed approximately 20 percent above rated speed. The shutdown device shall have a manual reset.
 - c. A tachometer to indicate revolutions per minute of the engine.
 - d. An oil pressure gauge.
 - e. A cooling water temperature gauge.
 - f. An hour meter that indicates the total time of engine operation.
 - g. A muffler, spark arrestor, and an expansion joint between the muffler and the engine.
 3. An engine cooling system designed for fresh water service of the closed circuit type. The capacity of the cooling system shall not be less than the cooling requirements of the engine, including the lubricating oil, while operating continuously at 100 percent of the specified rating. The cooling system shall include:
 - a. A jacket water circulating pump driven by the engine.
 - b. A copper-nickel or stainless steel heat exchanger.
 - c. A reliable engine jacket temperature regulating device.
 - d. An opening for filling the system, checking coolant level, and adding make-up coolant when required.
 - e. Water supply for the heat exchanger from the discharge of the pump, taken off prior to the pump discharge valve. The cooling water supply loop shall include shut off valves, a strainer, and a pressure regulating device.
 - f. A pressure gauge in the cooling water supply system on the engine side of the last manual valve.
 - g. A bypass with manual valves and a strainer installed around the control valve assembly.

4. An independent engine exhaust system shall be piped horizontally through the pump house wall and securely braced. The muffler(s) shall be located on the outside of the building. The system shall incorporate the following features:
 - a. The length shall not exceed 15'-0" unless the pipe size is increased on size for each 5'-0" of additional length.
 - b. A weather collar shall be provided where the exhaust pipe passes through the pump house wall.
 - c. A flanged, stainless steel flexible connection shall be made between the exhaust piping and the engine exhaust manifolds.
 - d. Insulation shall be provided on the exhaust piping and shall consist of completely non-combustible, non-asbestos materials.
 - e. The exhaust back pressure shall not exceed the engines manufacturer's recommendations.
 - f. The exhaust system shall be constructed of corrosion resistant components.

5. An Electric Engine Starting System in which the electric-starting device takes current from the storage batteries shall be provided. The electric engine starting system shall include:
 - a. Dual sets of 24 volt, high quality lead acid batteries (sized per NFPA 20) and terminals for required connection to the controller. The contractor shall provide certification that the batteries furnished comply with the cranking capacity requirements.
 - b. The main battery contactors supplying current to the starter shall be capable of manual mechanical operation to energize the starter in the event of a control circuit failure.
 - c. A fiberglass or other non-corrosive battery box and frame shall be provided.
 - d. All current carrying components shall be copper.

6. A Fuel Supply System located inside the fire pump house with the following features shall be provided:
 - a. An above ground fuel storage tank sized to allow eight (8) hours of full load operation or one (1) gallon per horsepower plus five (5) percent volume for expansion and five (5) percent volume for the fuel sump, whichever is greater.
 - b. Replaceable, cartridge type fuel filters with provisions for entrapping and removing water.

- c. The fuel storage tank shall have the following:
 - 1. A fill connection with catching covering.
 - 2. A fuel supply connection to the engine.
 - 3. A fuel return connection.
 - 4. A low level switch to provide a low level alarm whenever the tank has less than 80% capacity.
 - 5. An atmospheric vent with flame arrestor.
 - 6. Fuel connections on the tank shall be flanged.
 - 7. A water drain valve at the low point of the tank.
 - d. Stainless steel fittings and tubing.
7. The Engine Instrument Panel shall be provided in accordance with the following:
- a. Each engine shall include a 316 stainless steel engine instrument panel with the following indicators:
 - 1. Cooling water temperature
 - 2. Oil Pressure
 - 3. Tachometer
 - 4. Hour meter
 - 5. Other indicators as deemed necessary by the Contractor and agreed on by the Contracting Officer.
 - b. The instrument panel shall have a permanently attached 316 stainless steel or Monel nameplate with the following information stamped in 3/16 inch minimum letter height:
 - 1. Engine continuous horsepower rating
 - 2. Full load speed at continuous horsepower rating
 - 3. Fuel tank capacity
 - 4. Jacket cooling water system capacity
8. The engine shall operate without excessive vibration throughout the pump operating range.
- a. The right angle gear drive shall be spiral bevel geared, high efficiency, single reduction, and totally enclosed with a vertical hollow shaft. The gear shall have the following:
 - 1. A non-reverse ratchet mechanism which will prevent back spin of the pump shaft, right angle drive gears, and diesel engine.
 - 2. Thrust bearings with hollow shaft construction, designed with a safety factor of 1.5 to carry maximum pump shaft thrust.
 - 3. A gear ratio suitable for the rated speeds of the pump and driver. The gearhead shall be designed to transmit maximum horsepower required by the pump at any point throughout the pump characteristic curve from shutoff to maximum capacity.

4. Double universal joint coupling to connect to a diesel engine driver, complete with coupling guard, and stub shaft hubs. The coupling shall permit the engine or the pump to be removed without disturbing the other.
- D. Electric Fire Pump Controller: The driver shall have an automatically operating controller manufactured with the following features:
1. The controller shall be UL listed specifically for fire pump service.
 2. The controller shall be completely assembled, wired, and tested by the manufacturer prior to shipment.
 3. The controller enclosure shall be free standing NEMA 3R.
All switches required to keep the controller in the automatic position shall be within locked cabinets having break glass panels.
 5. A pilot light shall be provided to indicate that the controller is in the automatic position.
 6. A representative of the controller manufacturer shall be present at the installation site during start-up and acceptance testing.
 7. Terminals shall be provided in the controller to enable connections for annunciation of pump running, driver or controller trouble, and remote pump start.
 8. The controller shall have an adjustable time delay for sequential starting
 9. The controller shall provide automatic and manual starting and manual shut down.
- E. Diesel Fire Pump Controller: The driver shall have an automatically operating controller manufactured with the following features:
1. The controller shall be UL listed specifically for fire pump service.
 2. The controller shall be completely assembled, wired, and tested by the manufacturer prior to shipment.
 3. The controller enclosure shall be free standing NEMA 3R.
 4. All switches required to keep the controller in the automatic position shall be within locked cabinets having break glass panels.
 5. A pilot light shall be provided to indicate that the controller is in the automatic position.
 6. A representative of the controller manufacturer shall be present at the installation site during start-up and acceptance testing.
 7. Terminals shall be provided in the controller to enable connections for annunciation of pump running, driver or controller trouble, and remote pump start.
 8. The controller shall be equipped with a pressure recorder and a programmable weekly time clock. The weekly programmable timer shall automatically start the engine at the pre-set interval. Weekly test shall run the engine for at least 30 minutes at rated speed.

9. A pilot light shall be provided for each battery set to indicate when the battery set is in use.
10. The controller shall have a built-in dual battery charger with an amp and volt meter.
11. When normal cranking time has been exceeded, the "Over-Crank" alarm shall be activated. A silencing switch shall be provided with the alarm. After over-cranking, a manual switch shall be required to reset the alarm.
12. A cooling water temperature sensor shall activate a signal light and an audible alarm when the temperature rises above a predetermined level.
13. A lubricating oil low pressure sensor shall activate a signal light and an audible alarm when the pressure fails below a predetermined level.
14. An engine overspeed audible alarm and an automatic shutdown device shall be provided.
15. An audible alarm and an indicator light shall be provided for indicating a liquid level below the control point in the fuel tank.
16. An indicator light shall show engine on/off status.

F. Pressure Maintenance Pump

1. The pressure maintenance pump shall be a centrifugal pump suitable for fresh water service and have a rated capacity of 20 gpm and discharge pressure of 125 psig.
2. The pressure maintenance pump shall be electric motor driven.
3. The pressure maintenance pump shall be suitable for fire protection service.
4. The pressure maintenance pump shall have a 316 stainless steel nameplate stamped in letters 3/16 inch in height to indicate operating information.
5. The pressure maintenance pump shall be configured to take suction from the City Fire Main which is usually pressurized to about 50 psig and discharge to the water reservoir.
6. The pressure maintenance pump shall be provided with a dedicated controller designed to automatically start up at a fire main pressure on the fire pump discharge side of 100 psig and automatically shutdown at the fire main pressure on the fire pump discharge side of 120 psig.
7. The controller shall have a circuit breaker disconnect, a volt control circuit transformer, dry contacts for remote alarm, and a run period timer.
8. All current carrying components shall be copper, aluminum is not acceptable.
9. The controller shall be in a NEMA 3R enclosure.
10. All equipment shall be cleaned, primed, and painted.

G. Hose Valve Manifold Test Header:

1. Construct header of steel pipe conforming to ASTM A53 or A120, Schedule 40, black steel, with welding fitting conforming to ANSI B16.9 of the same materials and weight as the piping in which they are installed.
2. Inlet connections to hose valve manifold assembly shall be flanged conforming to ANSI B16.5 Class 150.

3. Each test header outlet shall have approved bronze hose valve with 2.5 inch National Standard male hose threads with cap and chain; outlet shall be located 3 feet above grade.
4. Welding shall be metallic arc process in accordance with ANSI B31.1, including qualifications of welders.

H.. Vibration absorbing mountings, steel spring type, sized as recommended by the mounting manufacturer for the service involved, and securely attached to slab and pump unit base.

2.2 ABOVE GROUND WATER PIPING SYSTEMS: Provide fittings for changes in directions of piping and for all connections. Make changes in piping sizes through standard reducing pipe fittings; the use of bushings will not be permitted. Jointing compound for pipe threads shall be pipe cement and oil, or graphite, and oil. Short pipe nipples shall be extra strong. The piping design flow rate velocities shall not exceed 20 ft/sec, or the manufacturer's recommendations, whichever is smaller. The same velocity limitation also applies to all underground piping.

A. Sleeves: Provide standard weight zinc coated steel pipe sleeves for all pipes passing through masonry walls, floors and ceilings. Extend sleeves completely through construction, and 4 inches above the floor. Pack space between sleeves and pipe with insulation and caulk at both ends with plastic waterproof cement.

B. Escutcheon Plates: Provide piping passing through floors, walls and ceilings with approved type, one piece or split type plates. Plates where pipe passes through finish ceilings shall be chromium plated. Other plates shall be of steel or cast iron, with aluminum paint finish. Securely anchor plates with set screws or other approved positive means.

C. DISINFECTION: Disinfect new fresh water piping in accordance with AWWA C601. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow to stand for minimum of 24 hours. Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 parts per million.

2.3 ALL BELOW GROUND PIPING SYSTEMS CORROSION PROTECTION: Provide polyethylene for pipe encasement shall be in tube or sheet form, minimum nominal thickness of 0.008 inches, conforming to ANSI/AWWA C105.

2.4 FLUSHING: Flush all new fire pump suction and discharge piping at 150 percent of rated pump capacity. The new fire pump may be used to attain the required flushing volume. Continue flushing operations until water is clear, but for not less than 10 minutes. Furnish flushing certification to the Contracting Officer.

- 2.5 ELECTRICAL WORK: Electrical work is specified in Section 16050, Basic Materials and Methods, Electrical, except for control and fire alarm wiring. Fire alarm system is specified in Section 15340, Fire Detection, Alarm and Equipment Activation Systems.
- 2.6 WIRING: Control wiring shall be provided under this section and shall conform to NFPA 70. Rigid metal conduit shall be used.
- 2.7 MOTORS AND CONTROLLERS: Motors and controllers shall be furnished with their respective pieces of equipment; shall conform to, and shall have all electrical connections provided under Section 16050, Basic Materials and Methods, Electrical; and shall be provided with maximum of 120 volt control holding circuits. Transformers shall be provided for low voltage control circuits. The cost of providing additional electrical service and related work shall be included under this section when motors and equipment furnished under this section are larger and sized indicated.

PART 3 - EXECUTION

3.1 CORROSION PROTECTION

- A. All underground ductile iron pipe, valves, fittings, and fire hydrants shall be encased in a polyethylene film in accordance with ANSI/AWWA Specification C105.

- 3.2 INSTRUCTING OPERATING PERSONNEL: Upon completion of the work, and at a time designated by the Contracting Officer, Provide the services of experienced technicians regularly employed by the manufacturer of the firm pumps and the drivers for a period of not less than one 8-hour working day for the instruction of Government operating personnel in the proper operation and maintenance of the equipment.

- 3.3 FIELD TESTING: Perform testing to demonstrate conformance with the contract requirements in the presence of the Contracting Officer.

- 3.4 PRELIMINARY TESTS: Tests on pumps, drivers, and equipment shall be performed and include the following: visual equipment checks to insure compliance with approved shop drawings, pump start-run to insure proper operation and to detect any leakage of piping, valves and fittings, sequence of operation check, verification that all required pump accessories have been provided, test of pump alarm devices, and all additional inspections and tests necessary to insure that the entire pump installation is correct, complete, and ready for operation. When all preliminary tests have been completed and all corrections made, submit to the contracting Officer a signed and dated request for a formal inspection by the contracting Officer.

- 3.5 FORMAL TESTS: The Contracting Officer will witness formal tests and approve all systems before they are accepted. Submit the request for formal inspection at least 15 working days prior to the date the inspection is to take place. A competent representative of the fire pump installer shall be present during the inspection. Tests shall include 100 and 150 percent capacity flows and pressures, and no-flow pressures for conformance with manufacturer's characteristic curves. At this inspection, any or all of the required tests shall be repeated as directed by the Contracting Officer. Manufacturer's certified shop test characteristic curves for each pump being tested must be furnished by the contractor at the time for the pump acceptance test. Everything required for testing shall be provided by the Contractor and all expenses, in connection with the tests, shall be defrayed by him.
- 3.6 PRE-PRIMING OF AFFF PIPING: The Contractor shall, after all testing is complete, activate the system so that the AFFF piping is filled with the foam/water solution, which shall remain in the piping after the system shut-down and re-setting of all controls.

SECTION 15340 - FIRE DETECTION, ALARM AND EQUIPMENT ACTIVATION SYSTEMS

PART 1 - GENERAL

- A. Work included in This Section: Materials, equipment, fabrication, installation and test in conformity with applicable codes and authorities having jurisdiction for the following:
- 1.1 Fire Detection, Alarm and Equipment Activation Systems: Zoned, closed circuit, electrically supervised, Class A, Including but not limited to the following:
- a. Manual fire alarm stations
 - b. Space smoke detectors
 - c. Building fire alarm panel
 - d. Interface panel
 - e. Audible and visual devices
 - f. Building transceiver
 - g. Lightning arrester
 - h. Omni directional antenna
 - i. Coaxial cable assembly
 - j. Flow and Tamper switch wiring
 - k. Rate-compensated heat detectors
 - l. Ultra violet/infrared detectors
 - m. All necessary appurtenances
- B. Related work and applicable requirements specified elsewhere:
- 1. Conduit and wiring, BASIC MATERIALS AND METHODS Section.
- C. Related work:
- 1. Section 15325 - Wet Pipe Sprinkler System
 - 3. Section 15330 - AFFF Fire Suppression Systems
 - 4. Section 15335 - Fire Pump Systems
- D. Existing system: All new equipment and systems shall be compatible with the existing fire alarm system, unless excepted, in written specifications and drawings that are a part of the contract and approved by Contracting, Base Communications and Base CEEE.
- 1.2 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. Factory Mutual System (FM) Publication:

Approval Guide (Equipment, Materials, Services for Property Conversation) 1995.

B. National Fire Protection Association (NFPA) Standards:

70-1993 National Electrical Code.

72-1993 National Fire Alarm Code

C. Underwriters Laboratories, Inc. (UL) Publications:

Fire Protection Equipment Directory (Jan 1995 with Quarterly Supplements)

UL 6 Rigid Metal Conduit.

UL 38 Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems.

UL 228 Door Closers-Holders, with or without Integral Smoke Detectors.

UL 268 Smoke Detectors for Fire Protective Signaling Systems.

UL 464 Audible Signal Appliances.

UL 467 Grounding and Bonding Equipment.

UL 521 Heat Detectors for Fire Protective Signaling Systems.

UL 632 Electrically Actuated Transmitters.

UL 797 Electrical Metal Tubing.

UL 864 Control Units for Fire Protective Signaling Systems.

UL 1242 Intermediate Metal Conduit.

D. Department of the Air Force:

ETL-90-09 Engineering Technical Letter, as amended by attachment to ANGR/CEE and ANG/CEE review comments

- 1.3 **QUALIFICATIONS OF INSTALLER:** Prior to installation, submit data for approval by the Contracting Officer showing that the contractor has successfully installed fire alarm systems and associated equipment of the same type and design as specified herein. The data shall include the names and locations of at least two installations where the Contractor has installed such systems. The Contractor shall indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. The design and installation of the fire alarm system shall be coordinated with the systems being furnished and constructed under **SECTIONS: WET PIPE SPRINKLER SYSTEM, AFFF FIRE SUPPRESSION SYSTEMS and FIRE PUMP SYSTEMS**. All the work covered by these sections shall be the responsibility of one fire protection firm. This firm shall be normally engaged in the field of fire protection with a registered fire protection engineer on staff. Certification of this qualification shall be submitted for approval.

1.4 **QUALITY ASSURANCE**

- A. **Standard Products:** Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicated items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.
- B. **Nameplates:** Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a non-corrosive and non-heat sensitive plate which is securely attached to the equipment.
- C. **Keys and Locks:** Locks shall be keyed alike.
- D. **Tags:** Tags with stamped identification number shall be furnished for all keys and locks.

- E. Verifications of Dimensions: The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.
- F. Compliance: The fire detection and internal alarm system shall be configured in accordance with NFPA 72. The central reporting systems shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible with existing equipment and be UL listed or FM approved in accordance with the applicable NFPA standards.
- G. Manufacturer's Services: Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.
- H. Provide this complete fire alarm system while the existing systems are still in full operation. Program or schedule all new connections to the existing systems with minimal down time and properly coordinated with the Communications Officer.

1.5 SUBMITTALS:

- A. Shop Drawings: Shop Drawings for the fire protection/detection system shall be **one integrated submittal**. This submittal shall include sprinkler plans and sections, oscillating monitor plans and sections, fire pump system plans and sections, fire detection and alarm plans and riser, and catalog cuts of proposed equipment. In addition, the shop drawings shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and the anchorage of equipment and appurtenances, and equipment relationship to the other parts of the work including clearances for maintenance and operation. Shop drawings shall be submitted on full-size mylar sheets. After updating all deviations, modifications, and changes, the shop drawings will represent the final (mylar) as-built drawings.

- B. Test Procedures: The Contractor shall furnish to the Contracting Officer detailed test procedures for the fire detection and alarm system 60 days prior to performing the system tests. The test procedures must be signed by a registered fire protection engineer. For qualifications of this engineer, see paragraph 1.3 QUALIFICATIONS OF INSTALLER.
- C. Spare Parts Data: After approval of the shop drawings, and not later than 2 months prior to contract completion, the Contractor shall furnish spare parts data for each different item of materials and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and a source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 year(s) of service.
- D. Calculations: Substantiating battery calculations shall be submitted for the supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component shall be submitted with the calculations. Battery recharging period shall be included with the calculations.
- E. Operating and Maintenance instructions for the system(s) and equipment furnished shall be in accordance with the requirements of this section.
- F. The Contractor shall furnish the Contracting Officer 6 complete copies of the operating instructions outlining step-by-step procedures required for system start up, operation, and shut down. The instructions shall include the manufacture's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Operating instructions shall be submitted and approved prior to the training course.
- G. The Contractor shall furnish the Contracting Officer 6 copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the systems installed. Maintenance instructions shall be submitted and approved prior to the training course.
- H. The Contractor shall conduct a training course for the operating staff as designated by the Contractor Officer. The training period shall consist of 3 training days (8 hours per day) and shall start after the system(s) is functionally completed but prior to final acceptance test. The field instructions shall cover all the items contained in the operating and maintenance instructions.

- I. Performance Test Reports: Upon completion and testing of the installed system, test reports shall be submitted in booklet form showing all field test performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of the controls.

1.6 DELIVERY AND STORAGE

- A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, and any other contaminants.

1.7 GUARANTEE

- A. Guarantee of all equipment and labor by manufacturer for one year from written notice of acceptance by the Government.

1.8 SYSTEM DESIGN

- A. Operation: Systems(s) shall be a complete, supervised zoned coded fire alarm system. The system shall be activated into the alarm mode by actuation of any alarm initiating device (see Attachment I). The system shall remain in the alarm mode until initiating device is reset and the fire alarm control panel is manually reset and restored to normal. Electrical supervision shall be Style D or E in accordance with NFPA 72. All circuits shall be capable of operating under a single ground or open condition, except primary and emergency power supplies.
- B. Operational Features: The system shall have the following operating features:
 - 1. Electrical supervision of alarm initiating circuits and alarm indicating circuits. Smoke detectors shall have combined alarm initiating and power circuits.
 - 2. Electrical supervision of circuits used to activate fire extinguishing systems. Supervision shall include the coil of the releasing solenoid.
 - 3. Electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, placement of alarm zone modules within the control panel, and transmitter tripping circuit integrity.

4. Trouble buzzer and trouble lamp (light emitting diode or neon light) to activate upon a single break, open, ground fault, or abnormal position of any switch condition which prevents the required normal operation of the system(s). The trouble signal shall also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, removal of alarm zone modules, and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator lamp. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal conditions. The trouble signal shall be transmitted to the central fire station.
 5. Transmitter disconnect switch to allow testing and maintenance of the system(s) without activating the transmitter.
 6. Evacuation alarm silencing switch or switches which, when activated, will silence alarm devices, but will not affect the zone indicating lamp nor the operation of the transmitter. This switch shall be overridden upon activation of a subsequent alarm from an unalarmed zone.
 7. Switch which will bypass AFFF (Aqueous Film Forming Foam) fire suppression system operation. Operation of the switch shall activate the system trouble signal.
 8. Electrical supervision of circuits used for supervisory signal services.
 9. Zones for alarm initiating circuits shall be arranged as indicated on the contract drawings.
- C. Alarm Functions: An alarm condition on a zone circuit shall automatically initiate the following functions:
1. Transmission of a signal via radio transmitter compatible with the existing Monaco System from alarm condition on heat detectors or UV/IR detectors.
 2. Visual indication of the zone operated on the fire alarm control panel annunciation from alarm condition on heat detectors or UV/IR detectors

3. Continuous sounding of alarm indicating devices throughout the building from alarm condition on heat detectors or UV/IR detectors
 4. Automatic discharge of the AFFF underwing monitors and automatic charging of AFFF pre-action sprinkler piping when any two cross-zoned rate-compensated heat detectors or AFFF manual fire alarm station is activated.
- D. Primary Power: Operating power shall be single phase taken from the building electrical service as specified. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm. Loss of AC power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.
- E. Emergency Power: Emergency power shall be through the use of rechargeable, sealed-type storage batteries and battery charger.

1.9 OVERVOLTAGE AND SURGE PROTECTION

- A. Power Line Surge Protection: All equipment connected to alternating current circuits shall be protected from power line surges. Equipment shall meet the requirements of ANSI C62.41. Fuses shall not be used for surge protection.
- B. Communications Link Surge Protection: All communications equipment shall be protected against surges induced on any communications link. All cables and conductors, except fiber optics, which serve as communications links shall have surge protection circuits installed at each end that meet the following two wave forms:
1. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 2. A 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Protection shall be provided at the equipment. Additional triple electrode gas surge protectors, rated for the application, shall be installed on each wireline circuit within three feet of the building cable entrance. Fuses shall not be used for surge protection.

- C. Sensor Wiring Surge Protection: All digital and analog inputs and outputs shall be protected against surges induced by sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested with the following two wave forms:
1. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 2. A 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Fuses shall not be used for surge protection.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. CONTROL PANEL shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a neat, compact assembly containing all components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic or metal identification plates for all lamps, zones, control, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble lamp shall be provided for each zone alarm initiating circuit, located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices (meters or lamps). Meters and lamps shall be plainly visible when the cabinet of the control unit is closed. Initiating circuits shall have plug-in cards or modules for ease of servicing. Signals shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Each initiating circuit shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including any or all batteries, shall not require the reloading of a program from any source. Upon restoration of power, start-up shall be immediate, automatic, and shall not require any manual operation. The loss of primary power shall not affect the transmission of alarm, supervisory or trouble signals. Enclosures shall be provided with ample gutter space to allow proper clearance between enclosure and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single enclosure large enough to accommodate all units.

- B. Additional Features: Fire alarm control panel shall provide all primary and emergency power for the operation and the supervision of the AFFF fire extinguishing system. Fire extinguishing systems powered from the fire alarm control panel shall be capable of being powered by the fire alarm system standby emergency batteries. No additional power sources necessary to activate the fire extinguishing systems will be permitted. All wiring used for supervision of or activation of the fire extinguishing systems shall be supervised. Any open or ground shall cause lighting of a trouble lamp and sounding of the system trouble buzzer or bell and transmission of trouble signal to the central fire station.
- C. Circuit Connections: Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each terminal marked for identification.
- D. FIRE ALARM TRANSMITTER shall be compatible with the existing base fire alarm receiving system. The existing system is Monaco.
- E. STORAGE BATTERIES shall be provided and shall be sealed, lead-calcium, lead-acid or nickel-cadmium with pocket plates types requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 24 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a period of 5 minutes. Batteries shall be sized to deliver 50 percent more ampere/hours than required for the calculated capacities. Battery cabinet shall be a separate compartment within the control panel.
- F. BATTERY CHARGER shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within 24 hours. A separate voltmeter shall be provided to indicate the state of the battery charge. Pilot light shall indicate when the batteries are manually placed on a high rate of charge as part of the unit assembly, if a high rate switch is provided. Charger shall be located in the control panel.
- G. MANUAL FIRE ALARM STATIONS shall conform to the applicable requirements of UL 38. Manual stations shall be connected into alarm initiating circuits. Stations shall be single action type. Stations shall be furnished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable; however, stations employing glass rods are acceptable. The use of key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the

voltage and current upon which they shall operate. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be painted the same color as the fire alarm manual stations.

H. FIRE DETECTING DEVICES shall comply with the applicable requirements of NFPA 72, UL 286, UL 286A, and UL 521. The detector shall be mounted as specified or indicated. Detector base shall have terminals for making connections. No solder connections will be allowed. Detectors shall be connected into alarm initiating circuits.

1. Heat Detectors: Heat detectors shall be designed for detection of fire by rate-compensating principle. The ratings for the rate compensated detectors shall be between 190 °F and 225 °F. Detectors shall be located in accordance with their listing by UL or FM and the requirements of NFPA 72. Maximum area of coverage shall be 400 square feet (20 foot x 20 foot) per detector. Detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations as defined by NFPA 70, shall be types approved for such locations. Detectors shall have screw terminals for making all wiring connections. Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Detectors shall be hermetically sealed and automatically resetting. Detectors shall be matrix-zoned (see Attachment I) in such a manner that operation of two zone selective detectors in the Hangar shall be necessary to actuate the underwing nozzle system. Actuation of the underwing nozzle system shall operate oscillating nozzles as indicated in zone schedule.

Operation of only one detector shall:

- a. Sound the AFFF pre-alarm signal - a “slow whoop” tone
- b. Annunciate an unconfirmed fire AFFF alarm at the building Fire Alarm Control panel (FACP) and transmit same to Base Fire Department Control Supervising Station Radio Receiving Console (CSSRRC).

Activation of any two cross-zoned detectors shall:

- a. Sound the AFFF pre-discharge signal - a “yelp/wail” tone.
 - b. Annunciate a confirmed fire AFFF alarm at the FACP and CSSRRC.
 - c. Trip the deluge valves on the pre-action sprinkler systems.
 - d. Open the AFFF concentrate solenoid valve supply the proportioner.
 - e. Activate the AFFF oscillating monitor system.
 - . Start the fire pumps.
 - g. Activate only hangar area exhaust fan shutdown systems.
2. Smoke Detectors: Detectors shall operate on the photoelectric light-scattering principle. The detectors shall be listed by Underwriters Laboratories or Factory Mutual approved. The smoke detector shall contain an infrared LED light source and a light sensing photodiode. Detector shall be capable of activating a remote indicating lamp on a remote annunciator. Smoke detector shall only provide an alarm capability at the FACP and CSSRRC.
3. Ultra-Violet/Infrared Detectors (UV/IR): UV/IR detectors shall have dual spectrum sensing and fire event analysis. Provide sufficient detectors to cover entire hangar area based on the viewing angle of the detector selected and manufacturer's instructions. Detectors shall be mounted on the wall with adjustable bracket. Each detector shall be capable of responding to a JP-4 fuel fire 2 ft x 2 ft at a distance of 100 or at the center of the hangar within 5 seconds. All detectors shall be supervised. The UV/IR combination flame detectors shall not be activated by intermittent or continuous direct reflected solar radiation, arc welding, lighting, radiant heat, X-rays, normal jet engine functions including direct exhaust blast, normal artificial lighting or radio transmissions. The UV/IR detectors shall only provide an alarm capability at the FACP and CSSRRC. In addition, detectors shall provide the following features:
- a. The detector logic will require UV and IR signals to be present in the proper ratio as emitted by a hydrocarbon fire and require a fire signal to be present for a minimum of 50% of each event period before confirming a fire.
 - b. The detector must include complete automatic self-testing including through the lens check, UV and IR sensor test, and electronic circuits including all logic and output relay coils without energizing the outputs.

- c. In addition to automatic self test, the detector must provide provision for manual testing including through the lens check, sensor test, and electronics circuits including all logic. The output circuits shall be energized.
- d. The detector shall be fully functional from -67 degrees F to +185 degrees F. Enclosure shall be passivated aluminum. Suitable for use in NEMA 4, watertight and dusttight environments and NFPA Class I, Division 1 Groups B, C and D: Class II Groups E and G environments, explosion-proof.
- e. The detector shall provide outputs for confirmed fire and fault and shall have capability to provide outputs for warning of excessive UV and IR background. All outputs shall be hermetically sealed relay contacts or optional; solid state collector transistor drive.
- f. The detector shall be self-contained with processing circuits necessary for confirming the presence of fire and ignoring those signals which would cause false alarms. The detector outputs shall be capable of direct interface with a FM approved releasing panel. The detector outputs shall also be capable of interfacing with annunciator panels and data acquisition systems.
- g. The UV/IR detectors shall be FM approved.
- h. Detector shall have optical/integrity to monitor the proper operation of the detector, cleanliness of viewing window, and sensitivity of sensors.
- i. Detector faults shall be digitally displayed.
- j. Detector shall be able to detect a fire in the presence of arc welding, X-ray, or background IR radiation.
- k. Detector/controller shall be user programmable to provide adjustable response of intensity and duration of response to signals.
- l. The UV/IR detectors shall be matrix-zoned (see Attachment I) in such a manner that the following alarm signals shall be provided:

1. Operation of any one UV/IR detector shall:
 - Sound the AFFF pre-alarm (slow whoop tone).
 - Annunciate an unconfirmed fire AFFF alarm at the building Fire Alarm Control Panel (FACP) and transmit same to the Base Fire Department Control Supervising Station Radio Receiving Console (CSSRRC).
 2. Operation of any two cross-zoned UV/IR detectors shall:
 - Sound the AFFF pre-discharge alarm (yelp/wail tone).
 - Annunciate a confirmed fire alarm at the building Fire Alarm Control Panel (FACP) and transmit same to the Base Fire Department Control Supervising Station Radio Receiving Console (CSSRRC).
- I. SIGNALING DEVICES: Audible signal devices shall be heavy duty, adjustable sound level type conforming to the applicable requirements of UL 446. Devices shall be connected into alarm indicating circuits.
1. Alarm Bells: Bells shall be 10-inch surface mounted with matching mounting back box. Bells shall be of vibrating type, suitable for use in an electrically supervised circuit. Bells shall be the underdome type producing a sound output rating of at least 87 dba at 10 feet. Bells used in exterior locations shall be specifically listed or approved for outdoor use and provided with metal housing and protective grilles. Single stroke, electrically operated, supervised, heavy duty, solenoid bells shall be used for coded applications. Bells shall have a separate screw terminal for each conductor.
 2. Alarm Horns: Horns shall be surface-mounted, vibrating type suitable for use in electrically supervised circuit and with a sound output rating of at least 87 DBA at 10 feet. Horns with metal housing and protective grilles shall be specifically listed for outdoor use in exterior locations. Horns shall have a separate screw terminal for each conductor. Alarm tones shall be as specified in Reference 1.2D of these specifications.
 3. Strobes: Strobes shall have high intensity optic lens and flash tubes. Strobes may be coupled with an audible signal device. Strobes shall flash at frequencies between three flashes per second and one flash every three seconds. Pulse duration shall be 0.2 second. Strobes shall be listed or approved for a minimum of 100 candela seconds. Strobes shall be surface mounted. Strobes shall have a separate screw terminal for each conductor.

- J. ANNUNCIATION PANEL: Panel shall be part of the fire alarm control panel. A visual annunciator shall be provided for each zone and spare zone as indicated. Each lamp shall provide specific identification of the zone by means of a permanently attached rigid plastic or metal sign with either raised or engraved letters. Zone identification shall consist of word description of the zone.

2.2 FIRE DETECTION AND ALARM PERIPHERAL EQUIPMENT:

- A. Conduit: Conduit shall be as specified in SECTION: ELECTRICAL WORK, INTERIOR.
- B. Wiring: Wiring for 120 V AC power shall be No. 12 AWG minimum. Wiring for low voltage DC circuits shall be No. 16 AWG minimum. Power wiring and control wiring shall be isolated. All wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing. Surface metal raceway shall be provided in finished areas. All conductors shall be color coded. Conductors used for the same functions shall be distinctively color coded. Two different color codes shall be used for each alarm circuit: one for each loop. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to the alarm initiating and alarm indicating circuits are unacceptable.
- C. Special Tools and Spare Parts: Special tools necessary for the maintenance of the equipment shall be furnished. Two spare sets of fuses of each type and size required and five spare lamps and LED's of each type shall be furnished. Two percent of the total number of each detector, but no less than two each, shall be furnished. Fuses and lamps shall be mounted in the fire alarm panel.
- D. Building Transceiver shall conform to the following:
1. Wall mounted NEMA 12 metal enclosure.
 2. Communication link between local alarm Control Panel and a Central Transmitter/Receiver.
 3. Monitor a minimum of 16 zones continuously monitored 10 times per second.
 4. Alarm codes shall be transmitted three times. Trouble codes shall be transmitted two times.
 5. Automatic re-setting of zone monitoring after trouble or alarm transmissions.
 6. Field addressable with address numbers 1 to 500
 7. Control switches and test LED indicators for "off system" testing.
 8. FCC type accepted VHF-FM transmitter and receiver.
 9. Shall transmit signals up to 35 miles.

10. Self monitoring of trouble conditions for AC power failure, low battery, and tampering with enclosure.
 11. Built-in transient voltage protection.
 12. 24 hour standby battery operation upon AC power failure.
 13. Power supply module with battery charging circuit.
 14. Shall supervise communication lines between the building's transceiver and the buildings fire alarm control panel.
 15. The unit must be approved by the Base Fire Department prior to shop drawing submittal.
- E. Interface Panel:
1. Shall interface the building's fire alarm control panel with the buildings transceiver.
 2. Shall operate at 24 V DC.
 3. Shall have a supervisory terminating resistance of 15,000 ohms +/- 5%, 0.5 watt.
 4. Shall have a voltage operating range of +/- 15% of rated voltage.
 5. Shall have contacts capable of drawing 50 amperes, minimum.
- F. Lighting Arrester:
1. Shall withstand 10 surges of 15,000 amperes in 5 micro seconds and a total charge of 21 coulombs.
 2. Shall have a breakdown voltage that will withstand as initial surge of 2,500 V DC and repeated surges of 1,500 V DC.
 3. Shall allow a maximum of 30 V DC to be applied to equipment during surge dissipation.
 4. Shall have a shunt capacitance of 16 nanofarads.
 5. Shall have a RF power capability of 1 KW RF 100% modulated AM.
 6. Shall have an impedance of either 52 or 72 ohms.
 7. Shall have a frequency range that goes up to 300 MHZ.
 8. Shall have a replacement indication of 10 M ohms, or less, center conductor to ground.
- G. Omnidirectional Antenna:
1. Receive and send signals equally in all directions.
 2. 3 db, 5/8 wave ground plane forward gain.
 3. Stainless steel construction.
 4. Vertical polarization.
 5. Maximum power rating of 200 watts.
 6. 52 ohms nominal RF impedance.
 7. VSWR at resonance 1.3 to 1 maximum.
 8. Shall have 4 ground wires.
 9. Shall have a wind load resistance that will withstand 125 mph.

10. Shall have a SO-239 RF connector.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation: All work shall be installed as shown on the approved shop drawings and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified.
- B. Power Supply for the System: A single dedicated branch-circuit connection for supplying power to each building system shall be provided. Emergency power supply shall be automatically transferred upon failure of the normal power supply.
- C. Wiring: Wiring for the systems shall be installed in 3/4 inch minimum diameter conduit; however, the wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting or power systems. No more than one conductor shall be installed under any screw terminal. All circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to terminals with each terminal marked in accordance with the wiring diagram for identification. Connections shall be made with either crimp-on terminal spade lugs or with approved pressure type terminal blocks. All wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of the wiring to the control panel.
- D. Control Panel: The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches above the finished floor nor more than 78 inches above the finished floor. All manually operable controls shall be at least 3 feet and less than 5 feet above the finished floor. Panel shall be installed to comply with the requirements of UL 864.
- E. Detectors: Detectors shall be installed in accordance with NFPA 72. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with the appropriate mounting hardware as required by its mounting location. Detectors which mount in free space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided.

1. Locations: Detectors shall be installed in the areas shown on the contract drawings. These drawings are schematic in nature and are intended to show the areas where detectors are required. The actual number and locations of detectors required shall be in accordance with the applicable sections of NFPA 72.
- F. Signaling Devices: Signaling devices shall be mounted a minimum of 8 feet above the finished floor unless limited by ceiling height or otherwise indicated.
- G. Annunciator Equipment: Annunciator equipment shall be mounted and provided where indicated.
- H. Grounding: Grounding shall be provided to building ground or ground rods shall be driven. Maximum impedance to ground shall be 25 ohms. Ground rods shall not protrude more than 6 inches above grade.

3.2 TEST

- A. TESTING: The Contractor shall notify the Contracting Officer 30 days before the performance and acceptance test are to be conducted. The tests shall be performed in the presence of the Contracting Officer under the supervision of the fire alarm system manufacturer's qualified representative. The Contractor shall furnish all instruments and personnel required for the tests.
- B. Preliminary Tests: Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed heat and smoke detector. Test shall include the meggering of all system conductors to determine that the system is free from grounded or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. Smoke detector bases shall be equipped with jumpers for the megger test. If deficiencies are found, corrections shall be made and the system shall be retested to assure it is functional.
- C. Acceptance Test: The testing shall be in accordance with NFPA 72 and shall verify that all previous deficiencies have been corrected. The test shall included the following:
 1. Test of each function of the control panel
 2. Test of each circuit in both trouble and normal modes.
 3. Test of alarm initiating devices in both normal and trouble conditions.

4. Test of each control circuit and device.
5. Tests of each alarm indicating device.
6. Tests of the battery charger and batteries.
7. Complete operational tests under emergency power supply.
8. Visual inspection of all wiring.
9. Opening the circuit at each alarm initiating and indicating device to test the wiring supervisory feature.
10. An operational test will be conducted involving the UV/IR detectors and the foam monitor cannons. The contractor shall furnish a 2 ft x 2 ft x 4 inch deep pan filled with water to within 1 inch of the top and add enough JP-4 fuel to provide sufficient fire to fill the pan. The Contractor shall also perform arc welding during the flame test to ensure system will activate while welding takes place. The pan shall be placed 100 ft from or centered between the UV/IR detectors. The contractor shall be liable for all damage and clean-up associated with the test. The Base fire department will provide a standby truck with a crew and a 150 lb Halon flight line fire extinguisher. The Contractor will also provide the initial and refill foam required for all tanks. The test will be repeated until satisfactory results are obtained at no additional cost to the Government. This test may be video taped by the Government.

3.3 POST CONTRACT MAINTENANCE

- A. Complete maintenance and service for the fire alarm system shall be provided by factory trained authorized representatives of the manufacturers of the major equipment for a period of two years after acceptance of the installation by the Contracting Officer.
- B. Maintenance and inspection service shall be performed by factory trained representatives of the major equipment manufacturers.
- C. Maintenance service shall include the following:
 1. Inspection:
 - a. Systematic examination of all equipment at six months intervals.

- b. Testing, cleaning, adjusting, repairing and replacing of all components as necessary, to keep the system in reliable condition and proper working order.
 - c. Furnishing all tools, test instruments, cleaning materials and parts required.
 - d. Battery and charger maintenance shall be included.
 - 2. Emergency Service:
 - a. Normal and overtime emergency call-back service shall consist of responding to calls within two hours of notification of system trouble.
 - b. Overtime emergency call-back service shall be limited to minor adjustments and repairs to effect the integrity of the system.
 - 3. Non-included Work: Maintenance service shall not include the performance of any work due to improper use, accidents or negligence for which the contractor is not directly responsible.
- D. Service and emergency personnel shall report to the Contracting Officer or his authorized representative upon arrival at the base and again upon completion of the required work. A copy of the work ticket containing a complete description of the work performed and parts replaced shall be given to the Contract Officer.
- E. The contractor shall maintain a log at the Central Station. The log shall list the date and time of all examinations and trouble calls, condition of the system, and name of the technician. Each trouble call shall be fully described, including the nature of the trouble, necessary correction performed, and parts replaced.

**Attachment I
Fire Alarm Matrix For Fuel
System Maintenance Hangar**

Input/Output Matrix (Fire Suppression System)	Pre-Alarm (Slow Whoop Tone)	Pre-Discharge (Yelp/Wail Tone)	Discharge (Pulsating Tone)	FACP & CSSRRC						Open AFFF Concentrate Solenoid Valve	Activate Hangar Drain Controls	Activate Hangar Exhaust Controls	Open Riser Deluge Valve	FACP & CSSRRC Abort	Close AFFF Riser Deluge Valves	Transmit Signal to FACP & CSSRRC
				Unconfirmed Fire	Confirmed Fire	AFFF Discharge	Wet Pipe Sprinkler Discharge	AFFF Hand Line Discharge	Start Fire Pumps							
Single UV/IR Detector	XXXX			XXXX												
Any Two Cross-Zoned UV/IR Detectors		XXXX			XXXX											
One Heat Detector	XXXX			XXXX												
Any Two Cross-Zoned Heat Detectors		XXXX			XXXX	XXXX (Monitors)			XXXX	XXXX	XXXX	XXXX	XXXX			
Any One Smoke Detector	XXXX			XXXX												
Wet Pipe System HAD			XXXX		XXXX		XXXX		XXXX							
AFFF Pre-action System HAD			XXXX		XXXX	XXXX			XXXX	XXXX	XXXX	XXXX	XXXX			
AFFF Monitor Manual Station			XXXX		XXXX	XXXX			XXXX	XXXX	XXXX	XXXX	XXXX			
Manual Pull Station	XXXX				XXXX											
AFFF Hand Hose Line Station			XXXX		XXXX			XXXX	XXXX		XXXX	XXXX				
AFFF Abort Station														XXXX	XXXX	
Trouble Signal																XXXX

SECTION 15411 - WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Requirements of the following Division 15 Sections apply to this section:
 - "BASIC MECHANICAL REQUIREMENTS".
 - "BASIC MECHANICAL MATERIALS AND METHODS"
 - "VALVES"
 - "SUPPORTS AND ANCHORS"

1.2 SUMMARY:

- A. This Section specifies the water distribution piping system, including potable cold, soft, hot, and recirculated hot water piping, fittings, and specialties within the building and to a point 5 feet outside the building.
- B. Related Sections: The following Section contains requirements that relate to this Section.
 - 1. Division 2 Section "POTABLE WATER PIPING" for specifying water service piping (which connects the "Water Distribution Piping" to wells and public utilities).
 - 2. Division 2 Section "EARTHWORK" for trenching and backfilling materials and methods for underground piping installations.
 - 3. Division 15 Section "BASIC PIPING MATERIALS AND METHODS" for materials and methods for sealing pipe penetrations through floors and fire and smoke barriers.
 - 4. Division 15 Section "METERS AND GAGES" for thermometers, flow meters, and pressure gages.
 - 5. Division 15 - Section "MECHANICAL IDENTIFICATION" for labeling and identification of piping system.

6. Division 15 - Section "PLUMBING PUMPS" for circulators and accessories.

7. Division 15 - Section "VALVES"

C. Products installed but not furnished under this Section include water meters that will be furnished by the Utility Company to the site and ready for installation if applicable.

1.3 SUBMITTALS

A. Product data for each piping specialty and valve specified.

B. Test reports specified in Part 3 of this Section.

1.4 QUALITY ASSURANCE:

A. Regulatory Requirements: comply with the provisions of the following:

1. ASME B 31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

2. UPC Uniform Plumbing Code.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Store pipe in a manner to prevent sagging and bending. Store piping with ends capped to prevent entrance of foreign material.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate the installation of pipe sleeves for foundation wall penetrations.

B. Coordinate with other trades to assure timely installations and to avoid conflicts and interference. Work closely with the metal stud partitions installer and/or mason to assure that anchors, sleeves, and similar items are provided in sufficient time to avoid delays; chases and openings are properly sized and prepared. Coordinate layout of water piping systems in all spaces, and identify all piping accurately and in accordance with coded paint color required.

1.7 EXTRA STOCK

- A. Maintenance Stock: Furnish one valve key for each key operated hydrant, bibb, or faucet installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Bibbs and Faucets:

Chicago Faucets
Hammed Valve Corp.
Nibco Inc.
Prier Brass Mfg. Co.
Watts Regulator Co.
Woodford Mfg. Co.

- C. Hydrants:

Josam Mfg. Co.
Smith, (Jay R.) Mfg. Co.
Wade Div. of Tyler Pipe.
Woodford Mfg. Co.
Zurn Industries Inc., Hydromechanics Div.

- D. Backflow Preventers:

Febco Sales, Inc.; Subs. of Charles M. Bailey Co., Inc.
Hersey Products, Inc.
ITT Lawler; Fluid Handling Div.
Watts Regulator Co.
Conbraco

- E. Relief Valves

Cash (A.W.) Valve Mfg. Corp
Conbraco Industries, Inc.
Watts Regulator Co.
Zurn Industries, Inc; Wilkins-Regulator Div.

F. Water Hammer Arresters:

Amtrol, Inc.
Josam
Sioux Chief
Smith (Jay R.) Mfg. Co.
Wade Div. of Tyler Pipe
Zurn Industries, Inc.; Hydromechanics Div.

G. Dielectric Unions:

Perfection Corp.
Watts Regulator Co.

H. Pressure-Regulating Valves

Cash (A.W.) Valve Mfg. Corp.
Cal-Val Co.
Spence Engineering Co., Inc.
Watts Regulator Co.
Zurn Industries Inc., Wilkins Regulator Div.

2.2 PIPE AND TUBE MATERIALS:

A. General: Refer to Part 3, Article "PIPE APPLICATIONS" for identification of systems where the below materials are used.

1. Drawn Temper Copper Tubing: ASTM B88, Type L.
2. Annealed Temper Copper Tubing: ASTM B88, Type K.

2.3 FITTINGS

- A. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.
- B. Dielectric Unions: Threaded or soldered end connections as required to suit application; constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

2.4 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, 95-5 Tin-Antimony.

2.5 VALVES

- A. General duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 15 Section "VALVES." Refer to Part 3 Article "VALVE APPLICATION" for specific uses and applications for each valve specified.

2.6 PIPING SPECIALTIES:

- A. Water Hammer Arresters: Bellows type, with stainless steel casing and bellows, pressure rated for 250 psi, or piston type, Type L copper tube casing, tested and certified in accordance with PDI Standard WH-201. Sizes called out on the plan are P.D.I. sizing symbols. Water Hammer Arresters shown in inaccessible chases shall be approved for that application.
- B. Hose Bibbs: Bronze body, renewable composition disc, removable keyed handle with key, 3/4" NPT inlet, 3/4" hose outlet, non-removable vacuum breaker.
- C. Projecting Non-Freeze Wall Hydrants: Cast bronze with chrome plated or nickel bronze face, tee handle key, vacuum breaker, 3/4" inlet and hose outlet. Bronze casing shall be length to suit wall thickness.
- D. Backflow Preventers:
 - 1. Reduced pressure principle assembly consisting of shutoff valves on inlet and outlet, and strainer on inlet. Assemblies shall include test cocks, and pressure-differential relief valve located between 2 positive seating check valves, and comply with requirements of ASSE Standard 1013.
 - 2. Double Check Valve Assembly consisting of two check valves between two NRS gate valves. Check valves shall be cast iron with bronze seats. Assembly shall include bronze body ball valve test cocks, and shall comply with ASSE Standard 1015.
- E. Relief Valves: Provide proper size for relief valve, in accordance with ASME Boiler and Pressure Vessel Codes, for indicated capacity of the appliance for which installed.
- F. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Provide temperature relief at 210 deg. F, and pressure relief at 150 psi.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPE APPLICATIONS

- A. Install Type L, drawn copper tubing with wrought copper fittings and solder joints for 6 inch and smaller, above ground, within building. Install Type K, annealed temper copper tubing for 6 inch and smaller, with minimum number of joints, below ground.

3.3 PIPING INSTALLATION:

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
 - 1. At Contractor's option, mechanically formed tees may be used in lieu of wrought copper tees for the domestic water lines as follows:

Use only for main lines of 2-1/2" line size and larger with branch lines at least two pipe sizes smaller than the main.

Mechanically extracted collars shall be formed in a continuous operation consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. The collaring device shall be fully adjustable as to insure proper tolerance and complete uniformity of the joint.

The branch shall be notched to conform with the inner curve of the run tube and dimpled to insure penetration of the branch tube into the collar if of sufficient depth for brazing and that the branch tube does not obstruct the flow in the main line tube.

All joints shall be brazed in accordance with the Copper Development Association Copper Tube Handbook using B-cup series filler metal.

Note: Soft soldered joints will not be permitted.

All mechanically formed branch collars shall be listed by the National Standard Plumbing Code, B.O.C.A., I.A.M.P.O., S.B.C.C., HUD, U.S. Army Corps of Engineers and Underwriters Laboratory.

- C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4 inch ball valve, and short 3/4 inch threaded nipple and cap.
- I. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical (link seal) sleeve seals. Pipe sleeves smaller than 6 inch shall be steel.
- J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Division 7 for special sealers and materials.

- K. Provide air compression chambers equal to 12 pipe diameters, 18" maximum, on all water supply connections to fixtures and equipment, except where water hammer arresters are installed.

3.4 HANGERS AND SUPPORTS

- A. General: Hanger, supports, and anchors devices are specified in Division 15 Section "SUPPORTS AND ANCHORS." Conform to the table below for maximum spacing of supports:
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 10 feet in length.
 - 2. Use copper plated hangers for copper piping.
- C. Install hangers with the following minimum rod sizes and maximum spacing:

Nom. Pipe Size	Max. Span-Ft.	Min. Rod-Size-Inches
3/4"	5	3/8
1	5	3/8
1-1/2	5	3/8
2	10	3/8
3	10	1/2
3-1/2	10	1/2
4	10	5/8
6	10	5/8

- D. Support vertical runs at each floor.

3.5 PIPE AND TUBE JOINT CONSTRUCTION

- A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual." Use 95-5 solder.
 - 1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering.
 - 2. Heat joints to proper and uniform temperature.

- B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:
1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 2. Align threads at point of assembly.
 3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
 4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
 - a. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- C. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

3.6 SERVICE ENTRANCE:

- A. Extend water distribution piping to connect to water service piping, of size and in location indicated for service entrance to building. Water service piping shall be Type K copper.
- B. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.
- C. Install a double check valve assembly with shutoff valves at service entrance inside building.
- D. Install water meter in accordance with Utility Company's installation instructions and requirements.
- E. Install shut-off valves, pressure reducing station, pressure relief valve and pressure gauge per plans.

3.7 VALVE APPLICATIONS

- A. General Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:
 - 1. Shut-off duty: Use ball valve for line sizes 2" and less. Use gate or butterfly valves for line size 2 1/2" and above.

3.8 INSTALLATION OF VALVES:

- A. Sectional Valves: Install sectional valves on each branch and riser, close to main, and elsewhere as indicated. For sectional valves 2" and smaller, use ball valves; for sectional valves 2-1/2" and larger, use gate or butterfly valves.
- B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated. For shutoff valves 2" and smaller, use ball valves; for shutoff valves 2-1/2" and larger, use gate or butterfly valves.
- C. Hose Bibbs: Install on exposed piping where indicated, with vacuum breaker.

3.9 EQUIPMENT CONNECTIONS:

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes and indicated, but in no case smaller than required by Plumbing Code.
- B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shut-off valve and union for each connection.

3.10 BACKFLOW PREVENTERS:

- A. Install where shown on plans and where required by the Uniform Plumbing Code. Locate in same room as equipment being protected. Provide funnel and pipe relief outlet to nearest floor drain. Test by certified technician prior to final acceptance.

3.11 FIELD QUALITY CONTROL:

- A. Inspections:
 - 1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.

2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made.
3. Re-inspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for re-inspection by the plumbing official.
4. Reports: Prepare inspection reports, signed by the plumbing official.

B. Test water distribution piping as follows:

1. Test for leaks and defects all new water distribution piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
3. Cap and subject the piping system to a static water pressure of 110 psi. Isolate the test source and allow to stand for a period of 4 hours. Leaks and loss in test pressure constitute defects which must be repaired.
4. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
5. Prepare reports for all tests and required corrective action.

3.12 ADJUSTING AND CLEANING:

A. Clean and Disinfect water distribution piping as follows:

1. Purge all new water distribution piping systems and parts of existing systems, which have been altered, extended, or repaired for a minimum of 4 hours prior to use.
2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority, the procedure described in either AWWA C601, or AWWA D105, or as described below:

- a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
 - b. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for 24 hours.
 - c. Drain the system, or part thereof, of the previous solution, and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - d. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water coming from the system.
 - e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
3. Prepare reports for all purging and disinfecting activities.

3.13 COMMISSIONING

- A. Fill the system.
- B. Before operating the system perform these steps:
 1. Open valves to full open position. Close drain, valves, hydrants, and sill cocks.
 2. Remove and clean strainers.
- C. Bleed all air from the system.

END OF SECTION 15411

SECTION 15420 - DRAINAGE AND VENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Division 1 Specification sections, apply to work of this section.

B. Requirements of the following Division 15 Sections apply to this section:

"BASIC MECHANICAL REQUIREMENTS"

"BASIC MECHANICAL MATERIALS AND METHODS"

"SUPPORTS AND ANCHORS"

1.2 SUMMARY:

A. This Section specifies building sanitary and storm drainage and vent piping systems, including drains and drainage specialties.

B. Related Sections:

Division 2 Section "EARTHWORK," for trenching and backfilling materials and methods for underground piping installations.

Division 2 Section "STORM SEWAGE SYSTEMS," for storm water drainage piping beginning from 5' - 0" outside the building.

Division 2 Section "SANITARY SEWAGE SYSTEM," for sanitary drainage piping beginning from 5' - 0" outside the building.

Division 15 Section "BASIC PIPING MATERIALS AND METHODS," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.

Division 15 Section "MECHANICAL IDENTIFICATION," for labeling and identification of drainage and vent piping.

1.3 SUBMITTALS:

A. Product Data for the following products:

Drainage piping specialties
Floor drains
Roof drains
Oil Separator

1.4 QUALITY ASSURANCE:

A. Regulatory Requirements: comply with the provisions of the following:

UPC Uniform Plumbing Code.

1.5 SEQUENCING AND SCHEDULING:

- A. Coordinate the installation of roof drains, flashing, and roof penetrations.
- B. Coordinate flashing materials installation of roofing, waterproofing, and adjoining substrate work.
- C. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing, and slope of slab to drains.
- D. Coordinate with installation of sanitary and storm sewer systems as necessary to interface building drains with drainage piping systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide drainage and vent systems from one of the following:
 - 1. Drainage Piping Specialties, including backwater valves, expansion joints, drains, trap primers, and vandal-proof vent caps:

Josam Mfg. Co.
Smith (Jay R) Mfg. Co.
Wade Div.; Tyler Pipe.
Zurn Industries Inc; Hydromechanics Div.

2. Grease Interceptor

Owens Corning
McTighe
Wemac
Highland Tank

2.2 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS:

- A. Hubless Cast-Iron Soil Pipe: CISPI Standard 301, Service weight, cast-iron soil pipe and fittings, with neoprene gaskets conforming to CISPI standard 310.

2.3 UNDERGROUND BUILDING DRAIN PIPE AND FITTINGS:

- A. Cast-Iron Soil Pipe: ASTM A74, standard weight, hub-and-spigot soil pipe and fittings. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces.

Neoprene Compression Gaskets: ASTM C564.

2.4 DRAINAGE PIPING SPECIALTIES:

- A. Backwater Valves: Valve assembly shall be bronze fitted cast-iron, with bolted cover. Flapper shall provide a maximum 1/4" clearance between flapper and seat for air circulation. Valve ends shall suit piping material.
- B. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.
- C. Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.
- D. Floor Cleanouts: Cast-iron body and frame, with cleanout plug and adjustable round top as follows:
1. Nickel-Bronze Top: Manufacturer's standard cast unit with exposed flush top, standard non-slip scored or abrasive finish, vandalproof cover. Stainless steel tamperproof screws.

- E. Wall Cleanouts: Cast-iron body adaptable to pipe with cast-bronze or brass cleanout plug; stainless steel cover including stainless steel tamperproof screws.
- F. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide underdeck clamp and sleeve length as required.
- G. Vent Flashing Sleeves: Cast-iron calking type roof coupling for cast-iron stacks.
- H. Vandal-proof Vent Caps: Cast iron body full size of vent pipe, with caulked base connection.
- I. Downspout Nozzles: Cast bronze downspout nozzle, loose wall flange and inlet threaded connection with rough bronze finish.

2.5 FLOOR DRAINS:

- A. Floor drain designations and sizes are indicated on Drawings.
- B. FD-1: Cast iron floor drain with flange, flashing collar with adjustable 4" x 8" rectangular satin nickel bronze strainer with stainless steel vandal-proof screws. Wade W-1100-H8-5 or equal.
- C. FD-2: Cast iron floor drain with flange, flashing collar with adjustable 5" dia. satin nickel bronze strainer secured with stainless steel vandalproof screws. Wade W-1102-STD5-5 or equal.
- D. FD-3: Cast iron floor drain with flange, flashing collar with adjustable 5" dia. satin nickel bronze strainer. Wade W-1100-STD5 or equal.
- E. Floor drains in boiler rooms, chiller rooms, and AHU rooms. Cast iron medium duty 12" dia. floor drain with flange, flashing collar and heavy duty loose set grate. Wade W-1210 or equal.
- F. Floor sink shall be cast iron with ARE interior, 12 x 12x 8 with aluminum sediment bucket and 3/4 grate. Wade W-1940-16-27.

2.6 ROOF DRAINS AND OVERFLOW ROOF DRAINS:

- A. Roof drain type designations and sizes are indicated on Drawings.
- B. Roof Drain: Suitable for use on single-ply roof. Cast-iron body and combined flashing collar and gravel stop, cast-iron dome, with the following features:

Underdeck clamp;
Extension as required for roof insulation;
Sump receiver;
Bottom outlet, inside caulk.

- C. Roof drains will be flashed with single ply roofing material by General Contractor.
- D. Overflow drains will be furnished with 2" high dam; either internal or external to strainer.

2.7 OIL INTERCEPTOR

- A. Storage capacity of 750 gallon minimum fuel oil.
- B. See schedule for required features..

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.
- C. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION FOUNDATION FOR UNDERGROUND BUILDING DRAINS

- A. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicate invert elevation.
- C. Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

3.3 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

- A. Install hubless service weight, cast iron, soil pipe and fittings for drainage and vent pipe.

3.4 PIPE APPLICATIONS - BELOW GROUND

- A. Install hub-and-spigot, service weight, cast-iron, soil pipe and fittings with gasketed joints for 15 inch and smaller drainage pipe.

3.5 PIPE AND TUBE JOINT CONSTRUCTION:

- A. Cast-Iron Soil Pipe: Make compression joints, and hubless joints in accordance with the recommendations in the CISPI Cast Iron Soil Pipe and Fittings Handbook, Chapter IV.

3.6 INSTALLATION:

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into account many design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
- C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inch and larger shall be Schedule 10 or Schedule 40 steel pipe.
- H. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Division 7 for special sealers and materials.

- I. Make changes in direction for drainage and vent piping using appropriate 45-degree wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn tees where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited
- J. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- K. Except where noted otherwise on the drawings, install building sanitary drain pitched down at minimum slope of 1/4" per foot (2 percent) for piping 3" and smaller, and 1/8" per foot (1 percent) for piping 4" and larger.

Install storm drain at 1/8" per foot (1 percent).
- L. Extend building sanitary drain to 5' outside of building, (or farther if shown otherwise on drawings) of size and in location indicated for service entrance to building. Sanitary sewer piping is specified in a separate section of Division 2. Make final connection to service main.
- M. Extend building storm drain to 5' outside of building, (or farther if shown otherwise on drawings) of size and in location indicated. Storm sewer piping is specified in a separate Section of Division 2. Make final connection to service main.
- N. Install sleeve and mechanical sleeve seal through foundation wall for watertight installation.

3.7 HANGERS AND SUPPORTS

- A. General: Hanger, supports, and anchors devices are specified in Division 15 Section "BASIC MECHANICAL MATERIALS AND METHODS." Conform to the table below for maximum spacing of supports:

- B. Install the following pipe attachments:

Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.

- C. Install hangers at the following intervals:

PIPE MATERIAL	MAX HORIZ SPACING	MAX VERT SPACING
	IN FEET	IN FEET
Cast-Iron Pipe	5	15

3.8 INSTALLATION OF PIPING SPECIALTIES:

- A. Install backwater valves in sanitary building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.
- B. Install expansion joints on vertical risers as indicated, and as required by the plumbing code.
- C. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:
 - as required by plumbing code;
 - at each change in direction of piping greater than 135 degrees;
 - at minimum intervals of 100';
 - at base of each vertical soil or waste stack.
- D. Cleanouts Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.
- E. Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.
- F. Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturer's instructions.

3.9 INSTALLATION OF FLOOR DRAINS:

- A. Install floor drains in accordance with manufacturer's written instructions and in locations indicated.
- B. Trap all drains connected to the sanitary sewer.
- C. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- D. Position drains so that they are accessible and easy to maintain.

3.10 INSTALLATION OF ROOF DRAINS:

- A. Install roof drains at low points of roof areas, in accordance with the roof membrane manufacturer's installation instructions. Locate overflow drains 2" higher than roof drains.
- B. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.
- C. Position roof drains so that they are accessible and easy to maintain.

3.11 INSTALLATION OF OIL INTERCEPTOR:

- A. Install per manufacturer's instructions and backfill to grade.
- B. Manhole rings to be set in concrete dock.

3.12 CONNECTIONS:

- A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.
- B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.13 FIELD QUALITY CONTROL:

A. Inspections:

1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
3. Re-inspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for re-inspected by the plumbing official.
4. Reports: Prepare inspection reports, signed by the plumbing official.

B. Piping System Test:

1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
3. Rough Plumbing Test Procedures: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
4. Finished Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Plug the stack openings on the roof and building drain where it leaves the building, and introduce air into the system equal to a pressure of 1"

water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the period of inspection. Inspect all plumbing fixture connections for gas and water leaks.

5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
6. Prepare reports for all tests and required corrective action.

3.14 ADJUSTING AND CLEANING:

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.15 PROTECTION:

- A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

END OF SECTION 15420

SECTION 15440 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.

B. Related Sections:

Separate grab bars and toilet accessories not an integral part of plumbing fixtures are specified in Division 10.

1.2 SUMMARY:

A. PLUMBING FIXTURES - GENERAL

1. All fixtures shall be furnished complete with trim. All exposed trim shall be chromium plated brass. China fixtures shall be of the best grade vitreous ware without pit holes or blemishes and the outlines shall be generally true. The Architect reserves the right to reject any pieces which, in his opinion are faulty.
2. All fixtures shall be set true and level with solid backing behind lavatory supports. Nipples through the wall to the fixture connection shall be brass and all necessary supports for the fixtures shall be installed before the wall is finished. All fixtures fitting against walls shall have ground backs. All fixtures shall be cleaned before setting, and the installation shall be left ready for use.
3. Fixtures indicated on the plans by a "P" number must be set and all plumbing connections required for its function installed. A detailed description of each fixture is on the plans or herein.

B. PLUMBING FIXTURE SCHEDULE: APPROVED MANUFACTURERS

Subject to compliance with requirements, provide products of one of the following:
Whenever possible all products will be provided by the same manufacturer.

1. China Fixture Manufacturers: American Standard - Crane - Kohler - Eljer.

2. Carrier Manufacturers: Zurn - Josam - Wade - J. R. Smith. Specific carriers shall be submitted for approval with fixture shop drawings.
3. Water Closet Seat Manufacturers: Church - Olsonite - Beneke.
4. Flush Valve Manufacturers: Sloan - Delany - Zurn.
5. Stainless Steel Security Fixtures: Bradley - Acorn - Metcraft.
6. Stainless Steel Fixtures: Elkay - Just - Kohler.
7. Drinking Fountain Manufacturers: Haws - Elkay - Halsey Taylor -Oasis.
8. Terrazzo Basins: Fiat - Stern Williams.
9. Plaster Trap: Wade - Josam - Zurn - J. R. Smith.
10. Bed Pan Washer: Chicago Faucet.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. UPC Uniform Plumbing Code.

- B. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect and Engineer. Burden of proof for equality of plumbing fixtures is on the proposer.

Trim shall be of model and manufacturer indicated, with no substitution.

1.4 SUBMITTALS:

- A. Product Data: Submit Product Data and installation instructions for each fixture, faucet, specialties, accessories, and trim specified; clearly indicate rated capacities of selected models of water coolers.

- B. Shop Drawings: Submit rough-in drawings. Detail dimensions, rough-in requirements, required clearances, and methods of assembly of components and anchorages.
- C. Maintenance Data: Include data in Maintenance Manual specified in Division 1 "GUARANTEE".
- D. Quality Control Submittals:
 - 1. Submit certification of compliance with specified ANSI, UL, and ASHRAE Standards.
 - 2. Submit certification of compliance with performance verification requirements specified in this Section.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Store fixtures where environmental conditions are uniformly maintained within the manufacturer's recommend temperatures to prevent damage.
- B. Store fixtures and trim in the manufacturer's original shipping containers. Do not stack containers or store in such a manner that may cause damage to the fixture or trim.

1.6 SEQUENCE AND SCHEDULING:

- A. Schedule rough-in installations with the installation of other building components.

1.7 MAINTENANCE:

- A. Extra Stock:
 - 1. Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Government with receipt in a quantity of one device for each 10 fixtures.

PART 2 - PRODUCTS

2.1 FITTINGS, TRIM, AND ACCESSORIES:

- A. Toilet Seats: elongated, solid white plastic, closed back/open front, less cover, and having stainless steel check hinge and replaceable bumpers unless otherwise specified on the plans.

- B. Supplies and Stops for non-security Lavatories and Sinks: polished chrome-plated, loose-keyed angle stop having 1/2" inlet and 3/8" O.D. x 12" long flexible tubing outlet, and wall flange and escutcheon.
- C. Traps: Cast brass, adjustable "P" trap with cleanout and waste to wall.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Examine rough-in for potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.
- C. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings, and pertinent codes and regulations, the original design, and the referenced standards.
- B. Comply with the installation requirements of Americans With Disabilities (ADA) with respect to plumbing fixtures for the physically handicapped.
- C. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.
- D. Install a stop valve in an accessible location in the water connection to each fixture.
- E. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork.
- F. Seal fixtures to walls and floors using a sanitary type, one part, mildew resistant, silicone sealant. Use pick-proof sealant on all security fixtures.

3.3 FIELD QUALITY CONTROL:

- A. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
- B. Inspect each installed unit for damage. Replace damaged fixtures.

3.4 ADJUSTING:

- A. Adjust water pressure at drinking fountains, faucets, and flush valves to provide proper flow and stream.
- B. Replace washers of leaking or dripping faucets and stops.

3.5 CLEANING:

- A. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

3.6 PROTECTION:

- A. Provide protective covering for installed fixtures, and trim.

END OF SECTION 15440

SECTION 15453 - PLUMBING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Division 15 Sections apply to this section:

"BASIC MECHANICAL REQUIREMENTS."

"BASIC MECHANICAL MATERIALS AND METHODS."

"BASIC PIPING MATERIALS AND METHODS."

1.2 SUMMARY

A. This Section includes the following types of plumbing pumps:

Inline circulators.

Submersible Sump Pumps

1.3 RELATED SECTIONS: The following sections contain requirements that relate to this section:

A. Division 3 Section "CONCRETE WORK" for specifications on concrete and reinforcing materials and concrete placing requirements for equipment pads.

B. Division 15 Section "VIBRATION CONTROL" for inertia pads, isolation pads, spring supports, and spring hangers.

C. Division 15 Section "HVAC PUMPS" for hydronic system centrifugal pumps.

D. Division 16 Section "ELECTRICAL CONNECTIONS FOR EQUIPMENT" for power-supply wiring including field-installed disconnects and required electrical devices.

E. Division 16 Section "MOTOR CONTROLLERS" for field-installed, a.c. motor controllers.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data including certified performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
- C. Shop drawings showing layout and connections for plumbing pumps. Include setting drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.
- D. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
- E. Maintenance data for plumbing pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 15 Section "BASIC MECHANICAL REQUIREMENTS."

1.5 QUALITY ASSURANCE

- A. Hydraulic Institute Compliance: Design, manufacture, and install plumbing pumps in accordance with "Hydraulic Institute Standards."
- B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."
- C. UL Compliance: Plumbing pumps shall be listed and labeled by UL and comply UL Standard 778 "Motor Operated Water Pumps."
- D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.
- E. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.
- F. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store pumps in a dry location.
- B. Retain shipping flange protective covers and protective coatings during storage.
- C. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:

Inline Circulators:

Aurora Pumps.
Amtrol, Inc.
Armstrong Pumps, Inc.
Bell & Gossett, ITT.
Taco, Inc.
Thrush

Submersible Sump Pumps:

Kenco
Hydramatic
Weil
Zoeller
Weinman

2.2 PUMPS, GENERAL

- A. Pumps and circulators: factory assembled and factory tested.
- B. Preparation for shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anti-corrosion compound. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

- C. Motors: Conform to NEMA standards; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection and grease-lubricated ball bearings. Select motors that are non-overloading within the full range of the pump performance curve. Provide motors with minimum efficiency and power factor as specified elsewhere herein.
- D. Apply factory finish paint to assembled, tested units prior to shipping.

2.3 INLINE CIRCULATORS

- A. General Description: Circulators shall be horizontal inline, centrifugal, separately coupled, single-stage, all-bronze, radially split case design, with mechanical seals, and rated for 125 psig working pressure and 225 deg F continuous water temperature.
- B. Casings: Bronze, with threaded companion flanges for piping connections smaller than 2-1/2 inches, and threaded gage tappings at inlet and outlet connections.
- C. Impeller: Statically and dynamically balanced, closed, overhung, single suction, fabricated from Rolled Temper brass conforming to ASTM B 36, and keyed to shaft.
- D. Pump Shaft and Sleeve: Steel shaft with oil-lubricated copper sleeve.
- E. Mechanical Seals: Carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.
- F. Pump Bearings: Oil-lubricated, bronze journal and thrust bearings or permanently lubricated ball bearings.
- G. Motor Bearings: Oil-lubricated sleeve bearings.
- H. Shaft Couplings: Flexible; capable of absorbing torsional vibration and shaft misalignment.
- I. Motors: Resiliently mounted to the pump casing.

2.4 SUBMERSIBLE SUMP PUMPS

- A. General Description: Pumps shall be Simplex or duplex as indicated on drawings, vertical, centrifugal, direct connected, end suction, single stage, bronze fitted, complete with integral inlet strainer, operating controls.

- B. Casings: Cast iron with integral cast-iron inlet strainer and legs to elevate the pump to permit flow into the impeller. Discharge companion flange shall be arranged for vertical discharge and suitable for plain-end pipe connection.
- C. Impeller: Statically and dynamically balanced, semi-open, overhung, single suction, fabricated from cast bronze conforming to ASTM B 584, keyed to shaft and secured by a locking capscrew.
- D. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
- E. Seals: Double mechanical seals.
- F. Motor: Hermetically sealed, capacitor start, with built-in overload protection explosion proof.
- G. Cover: Cast iron or steel perforated or grated round cover, access opening and openings for cords and discharge piping.
- H. Controls: Control panel with mercury float switches, circuit breaker, test-off-auto switch, control circuit fuses, high water alarm float switch. Connect remote alarm bell to panel.
- I. Accessories: Two discharge lines connected together through a "Y" fitting - each pump discharge fitted with union, check valve and gate valve - cast iron basin with gas tight cover - controls to include NEMA I float switch, alternator and auxiliary float switch - heavy copper float with guided float rod and copper float. Manual selection of pumps for single pump operation unless manually selected dual pump operation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

3.2 INSTALLATION

- A. General: Comply with the manufacturer's written installation and alignment instructions.
- B. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- C. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.
- D. Suspend inline pumps with all-thread hanger rod and vibration isolation hangers of sufficient size to support the weight of the pump independent from the piping system.
- E. Install sump pump basins in indicated locations. Refer to Section 03300 for Concrete Work.

3.3 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundations, after grout has been set and foundations bolts have been tightened, and after piping connections have been made.
 - 1. Adjust alignment of pump and motor shafts for angular and parallel alignment by one of the two methods specified in the Hydraulic Institute "Centrifugal Pumps - Instructions for Installation, Operation and Maintenance."
- B. After alignment is correct, tighten the foundation bolts evenly but not too firmly. Fill the base plate completely with non-shrink, nonmetallic grout, with metal blocks and shims or wedges in place. After grout has cured, fully tighten foundation bolts.
 - 1. Alignment tolerances shall meet manufacturers recommendations.

3.4 CONNECTIONS

- A. General: Install valves that are same size as the piping connecting the pump.
- B. Install suction and discharge pipe sizes equal to or greater than the diameter of the pump nozzles.
- C. Install a non-slam check valve, calibrated balance valve and ball valve on the discharge side of in-line pumps.

- D. Install a ball valve and strainer on the suction side of inline pumps.
- E. Install pressure gage connector plugs in suction and discharge piping around in-line pump. Pressure gage connector plugs are specified in Division 15 Section "Meters and Gages." Install aquastat to stop and start pump.
- F. Electrical wiring and connections are specified in Division 16 sections.
- G. Control wiring and connections are specified in other Division 15 sections.

3.5 FIELD QUALITY CONTROL

- A. Check suction lines connections for tightness to avoid drawing air into the pump.

3.6 COMMISSIONING

- A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:
 - 1. Lubricate oil-lubricated bearings.
 - 2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.
 - 3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
 - 4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.
- B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:
 - 1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
 - 2. Open the valve in the cooling water supply to the bearings where applicable.
 - 3. Open the cooling water supply valve if the stuffing boxes are water cooled.

4. Open the sealing liquid supply valve if the pump is so fitted.
 5. Open the warm-up valve of a pump handling hot liquids if the pump is not normally kept at operating temperature.
 6. Open the recirculating line valve if the pump should not be operated against dead shutoff.
 7. Start motor.
 8. Open the discharge valve slowly.
 9. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
 10. Check the general mechanical operation of the pump and motor.
 11. Close the recirculating line valve once there is sufficient flow through the pump to prevent overheating.
- C. If the pump is to be started against a closed check valve with the discharge gate valve open, the steps are the same except that the discharge gate valve is opened some time before the motor is started.

END OF SECTION 15453

SECTION 15458 - WATER HEATERS AND WATER SOFTENERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of water heater and water softener work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Refer to other Division-15 sections for water piping, and specialties, which are required external to water heaters and water softeners for installation; not work of this section.
- C. Electrical Work: Refer to Division-15 section "ELECTRICAL PROVISIONS OF MECHANICAL WORK" for requirements.
- D. Refer to Division-16 sections for other electrical wiring including motor starters, disconnects, wires/cables, raceways, and other required electrical devices; not work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of water heaters and water softeners of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. UL Compliances: Construct water heaters in accordance with the following UL standards:

UL 1453, "Electric Booster and Commercial Storage Tank Water Heaters".

2. Provide water heater components which are UL-listed and labeled.
- C. NEC Compliance: Install electric water heaters in accordance with requirements of NFPA 70, "National Electrical Code".
- D. ASHRAE Compliance: Provide water heaters with Performance Efficiencies not less than prescribed in ASHRAE 90A, "Energy Conservation in New Building Design".
- E. NFPA Compliance: Install gas-fired water heaters in accordance with requirements of NFPA 54, "National Fuel Gas Code".
- F. AGA Labels: Provide water heaters which are listed and labeled by American Gas Association.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data including rated capacities and efficiencies of selected model clearly indicated; operating weights; furnished specialties and accessories; and installation and start-up instructions.
- B. Shop Drawings: Submit manufacturer's assembly type shop drawings indicating dimensions, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for electrical power supply wiring. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of equipment and controls. Differentiate between portions of wiring that are factory-installed and portions that are to be field-installed.
- D. Maintenance Data: Submit maintenance data and parts lists for each type and size of water heater and softener, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Handle equipment and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged equipment or components; remove from site and replace with new.

- B. Store equipment and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with manufacturer's rigging and installation instructions for unloading equipment, and moving units to final location for installation.

PART 2 - PRODUCTS

2.1 COMMERCIAL GAS-FIRED WATER HEATERS:

- A. General: Provide commercial gas-fired water heaters of sizes and capacities as indicated on plan. Provide certification of design by AGA under Volume III tests for commercial water heaters for delivery of 180 deg F (82 deg C) water.
- B. Heater: Construct for working pressure of 150 PSI; boiler type hand hole cleanout; magnesium anode rod; 3/4" tapping for relief valve; glass lining on internal surfaces exposed to water.
- C. Safety Controls: Equip with automatic gas shutoff device to shut off entire gas supply in event of excessive temperature in tank; and pilot safety shutoff.
- D. Draft Hood: Equip with AGA certified draft hood.
- E. Jacket: Insulate tank with vermin-proof glass fiber insulation. Provide outer steel jacket with baked enamel finish over bonderized undercoating.
- F. Accessories: Provide brass drain valve; 3/4" pressure and temperature relief valve; and radiant floor shield.
- G. Controls: Provide gas pressure regulator; pilot gas regulator; thermostat; and temperature limit control.
- H. Manufacturers: Subject to compliance with requirements, provide commercial gas-fired water heaters of one of the following:

Bock Water Heaters, Inc.
Lockinvar Water Heater Corp.
PVI Industries, Inc.
Rheem Water Heater Div; City Investing Co.
Ruud Water Heater Div; City Investing Co.
Smith Corp. (A.O.); Consumer Products Div.
State Industries, Inc.
Viking Superior Corp.

2.2 AIRCRAFT/VEHICLE WASHER

- A. Standard Product: The Hydroblaster system defined herein is a standard Hydro Engineering Inc., design. The basic unit is a skid mounted 5/3000EHGV/M Hydroblaster. These units are installed (hard wired/hard piped) in place. Each unit is equipped with a completely configured Remote Equipment Module (REM) stanchion.
1. Access: The Hyrdroblaster system has been designed for complete accessibility for maintenance, parts replacement in the event of wear, breakage or required adjustments. Components will not exceed their design capability.
 2. Instructions and Manuals: A complete instruction manual will be provided with the delivery of each unit. This manual will include parts lists, operating procedures, daily requirements, inspections, preventative maintenance and repair information as required. This manual will also include all sub-contractor documents for the operation, control, maintenance and rework of all major sub-components.
- B. Materials: All material included in the fabrication of this equipment will be new and consistent with the requirements of Hydro Engineering designs as established for “Military” construction, which is at or above the fabrication standards for industrial/commercial grade equipment.
- C. Construction: The frame of the Hyrdoblaster is fabricated with heavy duty 3 inch channel iron and structural steel, with 6 inch steel legs. The electric motor and pump are mounted on a pre-formed 3/16 inch steel base plate. All access covers, inspection plates, skirt panels and the burner cover are stainless steel. The water proof stainless steel cover over the motor and pump is hinged for easy access. The REM stanchion is manufactured from 1/8 inch steel plate with 2x3 inch support column on a 14 inch square base with welded fillets. The backboard is 36” square and is 76” off the floor. Mounting bolt holes in the base are 1/2 inch with a 13 inch square bolt pattern. The backboard contains two commercial hand crank hose reels, a 1 GPM 60 PSI pneumatic pump and an explosion proof remote control switch.
- D. Workmanship: All external surfaces will be smooth and all edges will be rounded or beveled as required to provide a “snag-free” surface.
- E. Instruments and Controls: All controls are located on the front control panel of the EHGv unit and are identified with permanent decals for function and operation. The instruments consist of an hour meter and temperature gauge. The 0 to 5000 PSI pressure gauge is located on the outlet pressure pipe from the burner water coil.

F. Controls and Regulations:

1. Operating Controls: Panel mounted pump on/off switch with Magnetic motor starter. Three way “on/off/on” Burner control switch. (“ON” for control at machine - “OFF” to run with cold water and “ON” for remote switch selection.)
2. Remote Controls: A remote control system with Class I Division II Explosion proof off/on switch control box with control lights. Control system is 24 volt AC. One each provided and mounted on the REM for each 5/3000EHGV/M unit.
3. Flow Regulators: A regulator control system is provided to protect the pump and the fluid flow system. An unloader valve bypasses the fluid from the pump to the 2 gallon water breaker tank when the dual trigger gun is in the off position. The high pressure pop-off valve is a backup device to the unloader valve. It relieves excess fluid pressure at the pump, and also directs the fluid flow to the breaker tank. This is the Hydro Engineering redundant safety fluid flow control system.
4. Burner Controls: Three control systems are provided for safe burner operation and to prevent the coil from overheating: (NO standing pilot light)
 - (a), A flow control switch will turn off the burner when the fluid flow is zero.
 - (b), A high temperature limit switch will turn the burner off when the output fluid temperature exceeds approximately 225 degrees F. When the fluid temperature drops to normal, the burner is turned on again.
 - (c), A pressure control switch will turn the burner off when the fluid pressure is zero. This is the Hydro Engineering redundant safety burner control system.

G. Trigger Gun Operation: After the system has been turned on at the control panel, (or the remote switch), all operations are controlled by the trigger gun. When the trigger gun is in the “off” position, the pump goes into the bypass mode, the fluid circulates through the breaker tank, and the burner is turned off. Liquid flow and burner operation are controlled automatically as outlined above. The controls and regulators allow for gun operation, and provide operator safety and equipment protection should over pressure or over temperature conditions exist.

H. Instruction Decals: Permanent decals are located on the control panel which provides detailed operating instructions, functions of the controls and all safety warnings applicable to the operation of the Hydroblaster.

I. Safety Provisions: The fluid control system provides a pressure regulator and secondary pressure relief valve which redirects the fluid flow through the bypass system should an over pressure condition exist. The burner control system is controlled by fluid flow, high temperature and fluid pressure. This is defined as the Hydro Engineering operator redundant safety system. It eliminates over pressure and over temperature conditions, designed to physically protect both the operator and the Hydroblaster system. The electrical system is protected from phase failure, imbalance and reversal, overload and ground fault by a GFI system. The shutdown timer automatically shuts the system down when the equipment is not in use for a predetermined length of time. (generally 7 minutes).

J. PERFORMANCE AND PRODUCT CHARACTERISTICS:

1. Heating System: The burner is naturally aspirated and has a cast iron spreader ring with impinged brass burner jets. It is rated at 440,000 BTU's input and has a 10 inch exhaust stack. The coil is schedule 80 steel pipe with cold wrap insulator, and stainless steel insulated "cool touch" protective shield. The burner electrical system provides a 24 volt AC on-demand ignition system with electronic pilot. (no standing pilot light) The unit will operate on natural gas. A draft Diverter is provided with each unit. This system will provide a nominal 190 Degree F water temperature continuously.
2. Electric Motor: 10 HP, 440 volt, 3 Phase 60 Hz. Magnetic starter and shut-down timer. 30 AMP dedicated circuit required.
3. Pump: Ceramic triplex plunger with bronze and stainless steel fluid end, with oil bath crankcase.
4. Draft Diverter: A draft Diverter is provided with each 5/3000EHGV/M unit.
5. Water Breaker Tank: A 2 gallon stainless steel water breaker tank is installed between the outside water source and the pump. This unit dampens water surges and provides a reservoir for the pump recirculation by-pass operation.
6. Operating Temperature and Altitudes: The 5/3000EHGV/M system is designed to operate at ambient temperatures from 32 to 125 degrees F, at altitudes up to 6,000 feet above sea level. Water temperature decreases are proportional to altitudes above sea level.
7. Weight and Dimensions: Dry weight of the 5/3000EHGV/M = 460 pounds. The unit is 34" wide x 47" long x 50" high to the top of the burner.

8. Remote Equipment Module (REM). The stanchion is 68 inches high by 36 inches wide with a 14 inch square base. Approximate weight on the stanchion is 200 pounds with 2 reels with 100 feet of hose on each reel, the pneumatic soap pump and the Class I Division II Explosion proof remote switch mounted on the back board.

- K. Storage: Storage rings are provided on each side of the REM to hold the wands when not in use.

- L. Painting: The unit will be painted as follows:
 1. Painting: All non stainless steel surfaces will be coated with an acid etch primer and will have a polyurethane catalyzed acrylic enamel top coat on both the Hydroblaster and the Remote Equipment Module (REM).
 2. Markings: All markings on the Hydroblaster and REM are provided with permanent decals.

- M. Identification of Product: A name plate will be securely attached to the frame of the Hydroblaster and will contain the following information:
 1. HYDROBLASTER - EHG
 Model Number 5/3000EHGV/M2 or M4
 Serial Number.....
 Mfg. Name and Address: Hydro Engineering Inc., 865 West 2600 South, Salt Lake City, UT 84119 - Telephone 800-247-8424.
 2. REMOTE EQUIPMENT MODEL (REM):
 (same information as above)

- N. Accessories: In addition to the basic 5/3000EHGV/M units, the following will be included.
 1. Each EHG unit will be delivered with a Remote Equipment Module (REM Part number EHG-0025) and the serial number which will contain the following:
 - a. Hand crank Hose reel with 100 feet of 3/8 inch high pressure hose with applicable quick disconnects.
 - b. Hand crank Hose reel with 100 feet of 1/2 inch low pressure hose for soap delivery.
 - c. Pneumatic pump with foamer attachment- operated from standard 100 PSI shop air line. Rated at 1 GPM at 60 PSI for soap delivery.

- d. Remote switch: Class I Division II Explosion Proof control box with control light, 24 volt DC. Located 57 inches off the floor.
 - e. Dual shut off variable high pressure control trigger gun.
 - f. Shut-off trigger gun for low pressure soap delivery.
2. Each 5/3000EHGV/M will be equipped with the following:
- a. A draft Diverter to control the movement of cold air during inclement weather.
 - b. A set of Nozzles: High pressure stainless steel.), 15, 25, and 40 degrees on quick disconnects, and a chemical application 40 degrees low pressure nozzle. A complete set is provided with each EHGv unit in storage grommets on the body of the EHGv.
 - c. Legs to raise unit motor and burner, control circuits min of 18" AFF of hangar.
3. The Hydroblaster unit is designed to operate under all types of adverse conditions.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF WATER HEATERS:

- A. General: Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Support: Place units on concrete pads, orient so controls and devices needing service and maintenance have adequate access.
- C. Piping: Connect hot and cold water piping to units with shutoff valves and unions. Extend relief valve discharge to mop basin or floor drain.

- D. Gages: Provide thermometers on inlet and outlet piping of water heaters, in accordance with Basic Mechanical Materials and Methods Section "Meters and Gages."

3.3 GAS FIRED WATER HEATERS:

- A. Connect gas supply to gas line with drip leg, tee, gas cock, and union; full size of unit inlet connection. Locate piping so as not to interfere with service of unit.
 - 1. Flue: Connect flue to draft hood with gas-tight connection. provide flue of minimum size as flue outlet on heater. Comply with gas utility requirements.

3.4 FIELD QUALITY CONTROL:

- A. Start-Up: Start, test and adjust gas-fired water heaters in accordance with manufacturer's start-up instructions, and utility company's requirements. Check and calibrate controls, adjust burner for maximum efficiency.

END OF SECTION 15458

SECTION 15481 - COMPRESSED AIR SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Division 1 Specification sections, apply to this section.
- B. The requirements of the following Division 15 Sections apply to this Section:

BASIC MECHANICAL REQUIREMENTS
BASIC MECHANICAL MATERIALS AND METHODS
SUPPORTS AND ANCHORS

1.2 DESCRIPTION OF WORK

- A. This section specifies the equipment and piping systems to provide compressed air for owner provided equipment, shop use, and to control valves.
- B. Contractor provided equipment shall include:

Oiless Air Compressor
Air Compressor
Refrigerated Air Dryer
Air Regulators for control valves
Piping, fittings, valves, gauges
Air Purification System

- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 2 Section "Earthwork" for trenching and backfilling for installation of air piping.
 - 2. Division 7 Section "Joint Sealers" for materials and methods for sealing pipe penetrations through basement walls and fire/smoke barriers.
 - 3. Division 15 Section "MECHANICAL IDENTIFICATION" for labeling and identification of compressed air piping systems.

4. Division 15 Section "VALVES".
5. Division 15 Section "GAGES" for pressure gauges.

1.3 SUBMITTALS

- A. Product data for the following products:

- Oilless Air Compressor
- Air Compressor
- Refrigerated Air Dryer
- Pressure Gauges
- Valves
- Pressure Regulating Valves
- Air Intake Filters
- Air Purification System

1.4 SEQUENCING AND SCHEDULING:

- A. Coordinate the size and location of concrete equipment pads. Cast anchor-bolt inserts into pad, concrete reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate the installation of pipe sleeves for foundation wall penetrations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Subject to compliance with requirements, provide products by one of the following.

- A. Air Compressor:
Denver-Gardener
Emglo
Ingersoll-Rand
Quincy
Saylor-Beall
- B. Refrigerated Air Dryer:
Arrow
Hankison
Wilkerson

- C. Pressure Regulators:
Cash Valve Mfg. Co.
Fisher Controls
Spence Regulator
Watts
Wilkerson

2.2 PIPE AND TUBE MATERIALS:

- A. General: Refer to Part 3, Article "Pipe applications" for identification of systems where the below materials are used.
 - 1. Steel Pipe: Standard weight black steel ASTM A53 Grade B, seamless with malleable iron 300 lb screw type fittings.
 - 2. Copper Pipe: ASTM B88, Type K, hard temper, for design operating pressures of 400 PSI.
 - 3. Use dielectric unions between copper and steel pipe.

2.3 GENERAL DUTY VALVES:

- A. General Duty Valves: (i.e., gate globe, check, ball, and butterfly valves) are specified in Division 15 Section "General Duty Valves." Special duty valves are specified below by their generic name; refer to Part 3 Article "VALVE APPLICATION" for specific uses and applications for each valve specified.
- B. Drain Valves: shall be gate or angle valves.

2.4 AIR PRESSURE REGULATORS:

- A. Capacity shall be as shown on the plans.
- B. Features: Regulator shall be self-relieving, and be equipped with a pressure gauge.

2.5 AIR COMPRESSOR:

- A. Capacity shall be as scheduled on the plans.
- B. Features: Two stage air cooled reciprocating air compressor with precision machined cast iron pumps, totally enclosed metal belt guard.

- C. Tank: ASME horizontal receiver as scheduled, with legs and platform.
- D. Duplex Compressor Controls: Automatic alternation between the two compressors, utilizing both compressors during peak demand periods and standby air in the event of a primary compressor maintenance requirement.
- E. Motors: Industrial grade motor with automatic thermal overload protection, pre-wired magnetic starter.
- F. Accessories: Vibration isolators, tank gauge, check valve, tank drain, safety valve, outlet valve, automatic tank drain, air-cooled after cooler shall all be provided with the unit by the compressor manufacturer.

2.6 REFRIGERATED AIR DRYER:

- A. Capacity shall be as shown on the plans, at 100·F inlet air and 35·-39·F dewpoint.
- B. Features: Power-On light, inlet air pressure gauge, refrigerant analysis gauge, automatic 5-micron filter/drain with bowl guard, thermal overload protection.

2.7 COMPRESSED BREATHING AIR PURIFICATION SYSTEM

- A. Scope
 - 1. Work by seller
 - a. Design, fabricate, test and deliver a breathing air package in accordance with this specification.
 - b. Furnish under this specification: refrigerated chiller to reduce the moisture content of air; multistage coalescing filter to remove liquid oil, liquid water and particulate; a charcoal filter to remove tastes and odors; a catalyst to convert carbon monoxide to carbon dioxide and a particulate final filter to remove fine particles. All components shall be packaged with interconnecting piping inside a single enclosure requiring only utility and single inlet and outlet air connections.
 - c. Sellers manufacturing facility shall be certified by Underwrites Labs (UL) and registered to ISO9001 (ANSI/ASQCQ Q91:1987).

2. Work by buyer
 - a. Equipment installation
 - b. Piping connections to breathing air package from distribution system.
 - c. One 120 volt single phase power connection.
 - d. Drain connections to sump from breathing air purifier.
3. Codes and Standards (latest edition)
 - a. National Electrical Manufacturers Association (NEMA)
 - b. American Society for Testing Materials (ASTM)
 - c. American National Standards Institute (ANSI)
 - d. National Electrical Code (NEC)
 - e. ASME Boiler and Pressure Vessel Code, Section VIII
 - f. Occupational Safety and Health Act (OSHA)
 - g. Compressed Gas Association (CGA)
 - h. ISO9001 (ANSI/ASQC 90 Series)
4. Submittals
 - a. Seller shall provide
 - b. A reproducible drawing stamped certified for construction and signed by an authorized agent of the manufacturer.
 - c. Manuals for installation, operation and maintenance including specific instructions for filter replacements.
 - d. Elevation and Plan Drawings
 - e. Electrical Schematic
 - f. Mill Test Reports for ASME Code Vessels
 - g. Form U-1 manufacturer's data report

B. Products

1. Mechanical design and equipment design details

2. General design

- a. The breathing air package shall be complete unitized filtration and purification system. The integrated package shall produce respirable air from ordinary compressed air by using a combination of mechanically cooling the air, centrifugal action, impingement, absorption, adsorption and catalytic chemical reaction. The breathing air package accomplishes this by removing the liquid water, oil, particulate matter, moisture, odor and tastes and the conversion of carbon monoxide to carbon dioxide to produce clean, dry compressed breathing air. The quality of the air shall meet the standards set forth by the Federal Government (as published by OSHA) when the carbon monoxide concentration at the purifier inlet does not exceed 400 ppm. To meet Compressed Air and Gas Institute Commodity Specification G-7.1 for Grade D air when the CO content does not exceed 200 ppm, by volume. The air must not be oxygen deficient. The resulting air must meet Compressed Gas Association Standards for Grade D air ANSI/CGA G-7.1 in addition to OSHA and be suitable for face masks, hoods, helmets and other breathing apparatus. The unit shall deliver purified air as specified below:

Inlet Air Temperature - 100°F

Outlet Oxygen % - 19.5% - 23.5%

Outlet Oil (condensed) Content - 5mg/m³

Outlet CO Content - 20 ppm (OSHA) 10 ppm (CGA)

Outlet CO₂ Content - 100 ppm

Odor Total Delivered Capacity - scfm

None detectable

- b. All equipment specified herein shall be mounted in a common cabinet only to supply utilities and make tie-ins to form a complete functioning system.

3. Basic Design

- a. Air-to-refrigerant (chiller) heat exchanger.

- (1) Tube-in-tube heat exchanger to reduce the moisture content of the air by mechanically lowering the temp. to 35°F.

- (2) Equipment shall not require the use of any purge air to dry air and 100% of inlet air must be available to use at the outlet. Breathing air purifiers requiring purge air are not acceptable.
- b. Coalescing oil and water removal filters.
- (1) Multistage coalescing compressed air filter to remove liquid water, solid particulate, liquid oil and oil mists from the air. The filter shall have a theoretical filtration efficiency greater than 99.9999% and be capable of removing particulate as small as 0.01 micron.
 - (2) Filter shall use (in order to prevent early clogging of the element) centrifugal separation and impingement to remove up to 99+% by weight of contaminants before the compressed air reaches the element, in order to prevent early clogging of the element, while limiting excessive pressure drop and to provide a long life between element replacements. Contaminants thus removed shall drain into a sump with external drain connection.
 - (3) Filter elements shall consist of perforated support core and multiple layers of graded glass fiber coalescing medium which remove progressively smaller particles. Element shall also include a drain layer that consists of a PVC coated polyurethane foam that is compatible with all synthetic compressor lubricants that are in common use. The drain layer shall drain coalesced oil mists and droplets to a second sump with an external drain connection.
 - (4) The filter shall have an initial (dry) pressure drop of 0.4 psi and wetted pressure drop with clean element shall be 1.0-1 1/2 psid, at 100 psig and rated flow. The average pressure drop over life of elements shall be approximately 3.5 psi when replaced at the recommended interval of 7.0 psid. The filter shall include differential pressure indicator for indication of need for element replacement. The indicator shall be in the green zone when element is good and in the red zone to indicate need for element replacement.
 - (5) The filter housing shall be constructed of cast aluminum alloy with means to provide an audible signal should bowl be inadvertently loosened while filter is pressurized. The element core shall withstand pressure surges up to 100 psi differential.

- (6) The filter shall be provided with two automatic electronic drain valves with LED indicators for “Power ON” and “Drain Open” with manual push-to-test buttons. The valve body shall use viton seals and have a full 7/16” orifice. Drain valves are mounted pre-piped and pre-wired into package.
- d. Adsorption (activated charcoal) filter for odor and taste removal.
- (1) The adsorption (activated carbon) filter for odor and taste removal shall be a packed bed of carbon for highest oil vapor and odor retention by having longer contact time with air. Carbon impregnated filter media is not acceptable.
 - (2) Charcoal filter element shall be replaced every four months.
 - (3) Air-to-air (preheater/aftercooler) heat exchanger to preheat air entering reheater and to cool the air exiting the reheater.
 - (4) The preheater/aftercooler heat exchanger shall be tube-in-tube construction to allow cold air from adsorption filter to be preheated by cooling down air exiting the reheater. The function of this heat exchanger is to ensure air exiting the package is not greater than the inlet air temperature.
- e. Air-to-refrigerant (reheater) heat exchanger to heat air prior to entering catalyst to lower the relative humidity.
- (1) The reheater shall utilize the waste heat of the refrigerant system to heat up air prior to entering the catalyst to reduce the relative humidity to allow conversion of CO to CO₂ to occur in the catalyst.
 - (2) The preheater/aftercooler and reheater working together allow the humidity of the air to be lowered to levels required that CO can be converted to CO₂ and also by cooling air down after reheater the humidity rises making air more comfortable for long-term use over a desiccant type purifier.

f. Catalytic converter

- (1) A low temperature oxidation catalyst is used to reduce the CO concentration by converting it to less toxic carbon dioxide (CO₂). The oxidation catalyst is a mixture of inorganic oxide mainly manganese dioxide and copper oxide with additions of cobalt and silver oxides. The catalyst is not changed or consumed in the oxidation process.
- (2) The catalyst is capable of converting in excess of 95% of the CO in the air stream to CO₂. The conversion efficiency, however, decreases as the air stream relative humidity increases and its temperature decreases. To maintain an adequate conversion efficiency, the relative humidity of the air stream must be 1% or lower.
- (3) The catalytic converter shall convert carbon monoxide to carbon dioxide and must provide one year's continuous service before requiring cartridge replacement. The replaceable catalyst must be housed in a separate housing specifically designed for this purpose. Catalyst must be packaged in moisture proof packing and shall have a 30-month shelf life prior to installation in system.

g. Final Particulate Filter

- (1) The compressed air particulate filter for removal of solid particulate from air at a nominal 3.0 micron filtration. The initial (dry) pressure drop at inlet air pressure and rated flow shall not exceed 1 psid. The filter shall include a visual indicator for element replacement.
- (2) Filtration mechanisms shall be mechanical separation and interception. Filter housing shall incorporate a large-volume sump for the collection of separated particulate. Filter elements shall be replaceable and non-directional and shall be constructed of non-fiber releasing, pleated, bonded cellulose with polymeric elastomer end caps. Elements shall be replaceable without breaking air connections. The elements are to be pleated and have six (6) times the surface area of smooth elements to allow a longer service life.

- (3) The element is to be mounted on a steel support core and be capable of withstanding pressure surges up to 100 psi differential. The housing shall be constructed of cast aluminum alloy with means to provide an audible signal should bowl be inadvertently loosened while filter is pressurized. The housing shall incorporate a manual drain for periodic removal of contaminants collected in sump.
- h. Control and Alarm Monitoring System
- (1) Control enclosures shall be mounted in a cabinet on the breathing air purifier.
 - (2) Panel-mounted instrumentation shall include an LED digital readout to display refrigerant suction and discharge temperatures and inlet and outlet temperatures. Each readout shall include means to indicate when temperature is outside the normal operating range. Panel shall also include a light to signal when power is on.
 - (3) CO monitor shall be provided with audible and visual alarm for both high and low CO content, separately. Each condition is provided with an individual set of alarm contacts for remote annunciation.
 - (a) The monitor shall have a 5 second warm up time. Longer warm up time is unacceptable.
 - (b) The alarms shall have a positive 1 ppm CO hysteresis for both the high and a negative 1 ppm for the low alarm. This prevents excessive wear of mechanical devices interfaced with the alarm relays.
 - (c) The sensor life to be approximately 1-2 years with a 6-month warranty. Sensor to ship already installed in monitor and shall be easily accessible.
 - (d) The CO monitor/alarm shall have an audible alarm silence switch and an alarm push-to-test button.
 - (e) The air shall pass through a 4 way valve, a flow meter and into monitor. The 4 way valve prevents the monitor from becoming over-pressurized. 3 way valve not acceptable.

- (f) Monitors requiring air sample to be moisture are not acceptable.
 - (g) Each alarm is supplied with dedicated (N.O.) normally open and (N.C.) normally closed contacts. Alarm LED status is provided for each alarm on the front panel, as well as common piezoelectric horn mounted on the bottom of the monitor.
- (4) All alarms shall be provided with local annunciation.
 - (5) The LED display range is 0-200 ppm CO with +/- 1 ppm resolution and +/- 1% full scale linearity.
 - (6) The temperature range of sample air shall be 23°F to 120°F, with a flow of 1-5 scfm minimum, and an ambient temperature range of 35°F to 125°F.
- i. Design Pressure and Temperature
 - (1) The maximum pressure shall be 150 psig.
 - (2) The rated capacity is based on 100 psig and 100°F inlet air temp with 120°F max. inlet air temp.
 - j. The compressed breathing air purification shall be Deltech Pyramid 8000 Series Refrigerated Air Purifier, model number 8DM50 or approved equal.

2.8 OILLESS AIR COMPRESSOR

- A. Frame: Cast iron with cylinders bolted directly to frame. Frame is primed throughout to prevent corrosion. No oil to be used inside frame.
- B. Crankshaft: Large diameter ductile iron crankshaft with oversized, permanently sealed ball bearings, located on the front and rear, support crankshaft in the frame. Entire shaft is balanced with integral counter weight to ensure smooth operation.
- C. Connecting Rods: Single piece aluminum connecting rods with sealed needle bearings on piston pin end and sealed ball bearings on crank shaft end require no maintenance or adjustment and provide smooth operation for long life.

- D. Piston Rings and Rider Bands: Aluminum pistons with (2) compression rings and (2) rider bands. Rings and rider bands are made of Teflon. Thermal insulator prevents the transfer of heat of compression from the piston to the piston pin bearing.
- E. Cylinders: Nickel plated cast iron cylinders are supplied with the highest (5RMS) possible surface finish. Ring life of 6000 hours in constant duty operation.
- F. Dual Cooling: Cast iron flywheel directs a high volume of cooling air across the frame and cylinders. Squirrel cage fan mounted on front of crankshaft directs air across heads to provide additional cooling for valves.
- G. Valves: Aluminum heads are mounted on top of efficient stainless steel strip valves. Valves are rated for 8000 hours and require no lubrication.
- H. Lubrication: Compressor is to be 100% oil free, no lubrication required.
- I. Receiver Mounted: The duplex unit includes two bare compressors with two motors mounted on a single receiver. Each compressor / motor configuration is designed to operate as an independent unit. After cooler is provided for each compressor / motor configuration and an auto drain valve is furnished to drain condensate from receiver tank.
- J. Combination Alternator: A NEMA 1 combination alternator panel is furnished to enable both compression units to operate based on system demand. Mounted panel includes (2) motor starters with thermal overload relays, a control relay for alteration to ensure equal wear and provide backup air, (2) on / off switches and (2) two hour meters, (2) fused disconnect switches with door interlock, two 120 volt control transformers, and two reset buttons. Panel is UL and CSA approved.
- K. NFPA 99 Package Option: Option to include all items required on a duplex oil-less compressor package to meet medical air specifications of NFPA 99 (1993 Edition). All items to be factory mounted, included are: a (2) valve receiver by-pass system; an extra pressure gauge to indicate medical air system pressure should the receiver tank be by-passed; a liquid level line to show any moisture in the receiver tank; compressor isolation valves; a NEMA 1 high air temperature switch (with reset) for each compressor sensing the temperature in the discharge manifold block; and a special NEMA 1 (UL & CSA approved) combination alternator panel which includes (2) NEMA rated starters with overloads, one (1) control relay for alternation, two (2) fused disconnect switches with door interlock, two 120 volt control transformers, two (2) high air temperature shutdown lights, one lag compressor on light, two (2) hourmeters, one horn with silencer / reset button, and alarm contacts for wiring to customer's remote alarm system to indicate high air temperature shut down and lag compressor on. Equipped for automatic start / stop operation with NEMA 1 pressure switches.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine areas and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of the compressor. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine connections on owner supplied equipment to verify actual locations of piping connections prior to installation.

3.2 PIPE APPLICATIONS:

- A. Above ground within the building use standard weight black steel with malleable iron Class 300 fittings.
- B. Below ground outside of the building use Type K copper.

3.3 PIPING INSTALLATION:

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and branch connections.
- C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, where possible.
- F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Locate groups of pipes parallel to each other, spaced to permit servicing of valves.

- H. Install drains at low points in mains, risers, and branch lines as detailed.
- I. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls with sleeves and mechanical sleeve seals equal to link-seal. Pipe sleeves shall be steel pipe; with water stop.
- J. Fire Barrier Penetrations: Where pipes pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 7 for special sealers and materials.
- K. Install piping with 1/32-inch-per-foot (1/4 percent) downward slope towards drain point.

3.4 HANGERS AND SUPPORTS:

- A. General: Hanger, support, and anchor devices conforming to MSS SP-69 are specified in Division 15 Section "Supports and Anchors."

3.5 VALVES:

- A. Install ball or gate valves as indicated on the plans and details.

3.6 FINAL CONNECTIONS:

- A. Final connections to every piece of Contractor and Government furnished equipment including hydraulic lifts, dryer, boiler burner.

3.9 FIELD QUALITY CONTROL:

- A. Adjust air pressure regulators to specified pressure.
- B. Start-up, test and adjust air compressor in accordance with manufactures start-up instructions.

END OF SECTION 15481

SECTION 15483 - FUEL OIL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Division 15 Sections apply to this section:

BASIC MECHANICAL REQUIREMENTS.
BASIC MECHANICAL MATERIALS AND METHODS
GENERAL DUTY VALVES
SUPPORTS AND ANCHORS

1.2 SUMMARY

A. This Section includes fuel oil piping system and equipment, including:

Piping, fittings, and specialties.
Oil transfer equipment.
Oil storage tanks and accessories.

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

1. Division 2 Section "EARTHWORK" for excavation, trenching, and backfilling for underground oil storage tanks and underground piping.
2. Division 3 Section "CONCRETE WORK" for cast-in-place concrete, reinforcing, and formwork for equipment pads and ballast pads for underground oil storage tanks.
3. Division 15 Section "METERS AND GAGES" for oil supply and return line thermometers, and pressure and vacuum gages.
4. Division 15 Section "MECHANICAL IDENTIFICATION" for labeling and identification of fuel oil piping and transfer equipment.

1.3 DEFINITIONS

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

1.4 SUBMITTALS

- A. Product data for the following products:
 - 1. Special duty valves.
 - 2. Fuel gauge.
 - 3. Oil piping specialties.
 - 4. Oil storage tanks and accessories.
 - 5. Tank monitoring system. (Veeder Root)
 - 6. Overfill and spill protective devices.
 - 7. Oil water separator
- B. Shop Drawings detailing fabrication and installation of oil storage tanks and accessories. Detail equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Wiring Diagrams detailing wiring for power and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
- D. Maintenance data for oil transfer equipment, for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 15 Section "Basic Mechanical Requirements."

1.5 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications".
- B. Regulatory Requirements: Comply with provisions of the following codes:
 - 1. NFPA 31 - Standard for the Installation of Oil Burning Equipment, for oil piping materials and components, oil piping installations, and inspection, and testing of fuel oil piping systems.

2. Uniform Plumbing Code 1988 Edition.
- C. UL Compliance: Provide fuel oil piping components and storage tanks which are listed and labeled by UL.
1. UL 343 - "Standard for Pumps for Oil-Burning Appliances," for oil transfer pumps.
 2. UL 567 - "Pipe Connections for Flammable and Combustible Liquids and LP-Gas," for pipe connectors for fuel oil piping systems.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete pads for storage tanks, and housekeeping equipment pads for oil transfer pumps. Cast anchor bolt inserts into pad. Concrete reinforcement, and formwork requirements are specified in Division 3.

1.7 WARRANTY

- A. Special Product Warranty: Submit a written warranty for the aboveground fuel oil storage tanks, executed by the manufacturer, agreeing, at the manufacturer's option, to repair the failure, replace the failed tanks limited to delivery of new tank to the site of original installation, or refund the original purchase price of the tanks, provided the tanks are installed in accordance with the manufacturer's instructions. Warranty shall protect the Government for a period of 30 years from the date of original purchase, against failure of the tanks due to external corrosion, and internal corrosion when the tanks are used for storage of fuel oils at temperatures not exceeding 150 deg. F. This warranty shall be in addition to, and not a limitation of, other rights the Government may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Special Duty Valves:

Webster Electric Co., Sub. of Sta-Rite Industries, Inc.

2. Vertical Ball Check Valve:

Lunkenheimer

3. Strainers:

Armstrong Machine Works.
Hoffman Specialty ITT; Fluid Handling Div.
Metraflex Co.
R-P&C Valve; Div. White Consolidated Industries, Inc.
Spirax Sarco.
Trane Co.
Victaulic Co. of America. (low pressure applications only)
Watts Regulator Co.

4. Oil Piping Specialties:

McDonald Mfg. Co., A.Y.
OPW Division; Dover Corp.

5. Above Ground Double Wall Oil Storage Tanks: Tank to be U.L. approved, double wall, 2 hr. Fire rated and ballistics rated with electronic level gauge/indication with 0-20 mA connection to DDC system.

Wemac
Convault
Lube Cube

2.2 PIPE AND TUBE MATERIALS

- A. General: Refer to Part 3 below, Article "PIPE APPLICATION" for identification of systems where the below specified pipe and fitting materials are used.
- B. Steel Pipe: ASTM A 53, Schedule 40, Grade B seamless or ERW, black steel pipe, with beveled ends. Use above grade only.
- C. Copper Tubing: ASTM B 88, Type L, soft temper copper tubing and Type K, annealed copper tubing. Use below grade only.

2.3 FITTINGS

- A. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- B. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- C. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.
- D. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.
- E. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125; raised ground face, bolt holes spot faced. Threads shall conform to ANSI B1.20.1.
- F. Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets of the following material group, end connection and facing:

Material Group: 1.1.
End Connections: Butt Welding.
Facings: Raised face.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, Classification BAg1 (silver).
- B. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.5 PIPING SPECIALTIES

- A. Unions: ANSI B16.39, Class 150, malleable iron; female pattern; brass to iron seat; ground joint. Threads shall conform to ANSI B1.20.1.
- B. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

- C. Y-Pattern Strainers: 125 psig working pressure; cast-iron body conforming to ASTM A 126, Class B; flanged ends for 2-1/2 inch and larger, threaded connections for 2 inch and smaller, blotted cover, perforated stainless steel screen, and plugged blow-down drain.
- D. Flexible Connectors: minimum 150 psig working pressure, maximum 250 deg F operating temperature; stainless steel bellows with woven flexible bronze wire reinforcing protective jacket. Connectors shall have flanged or threaded end connections to match equipment connected; and shall be capable of 3/4 inch misalignment.

2.6 GENERAL DUTY VALVES

- A. General duty valves (ie., gate, globe, ball, and butterfly valves) are specified in Division 15 Section "General Duty Valves." Special duty valves are specified in this Article by their generic name. Refer to Part 3 below, Article "VALVE APPLICATION" for specific uses and applications for each valve specified.

B. SPECIAL DUTY VALVES

1. Oil Safety Valves: 250 psig maximum working pressure, 550 deg. F. maximum operation temperature; ASTM B 61 bronze body and bronze bases and discs, and field adjustable cadmium-plated carbon steel springs factory-set at 20 percent above operating pressure. End connections shall be inside threaded with threads conforming to ANSI B1.20.1. Valve shall be UL-listed for flammable or volatile liquids.
2. Vertical Ball Check Valves: Class 200, 400 psig maximum operating pressure, 2-piece bronze construction with threaded end connections; integral bronze seats and replaceable stainless steel ball.

2.7 OIL WATER SEPARATOR

Plans and Specification based on Highland Tank & Mfg. Co. Model HTC-2000 parallel corrugated plate gravity displacement Oil Water Separator. Separator dimensions are 5'-4" in diameter, 12'-0" long, having a total volume of 2000 gallons.

A. Application

The separator shall be designed for gravity separation of free oils (hydrocarbons and other petroleum products) along with some settleable solids from water. The source of the influent to the separator shall be gravity flow from hangar water runoff and the Fire Protection Discharge Reservoir.

B. Performance

1. Influent Characteristics

Provide Oil Water Separator designed for intermittent and variable flows of water, oil, or any combination of non-emulsified oil-water mixtures ranging from zero to 200 gpm. Operating temperatures of the influent oil in water mixture shall range from 40° F. to 180° F. The specific gravities of the oils at operating temperatures shall range from 0.68 to 0.95 and the petroleum hydrocarbon concentration less than or equal to 200,000 mg/l (20%). The specific gravity of the fresh water at operating temperatures shall range from 1.00 to 1.03.

2. Effluent Characteristics

The oil and grease concentration in the effluent from the oil water separator shall not exceed 10 mg/l (10 ppm). To achieve this goal, it will be necessary to remove all free oil droplets equal to and greater than 20 microns.

C. Design Criteria

1. The oil water separator shall be designed in accordance with Stokes Law and the American Petroleum Institute Manual on Disposal of Refinery Wastes, Volume on Liquid Wastes as stated in Chapter 5, Oil Water Separator Process Design and API Bulletin No. 1630 First Edition, Waste Water Handling and Treatment Manual for Petroleum Marketing Facilities.

The oil water separator shall comply with the following design criteria:

2. Capacities, dimensions, construction, and thickness shall be in strict accordance with Underwriters Laboratories, Subject UL-58 Standard for Safety, Steel Underground Tanks for Flammable and Combustible Liquids.

3. Corrosion Control System shall be in strict accordance with sti-P3 specifications as applied by a licensee of the Steel Tank Institute. Manufacturer must be a licensee of Steel Tank Institute. No assigning or subcontracting of sti-P3 licensing shall be permitted.
4. Separator shall be the standard product of a steel tank manufacturer regularly engaged in the production of such equipment. No subcontracting of tank fabrication shall be permitted.
5. Separator shall be fabricated, inspected and tested for leakage before shipment from the factory by manufacturer as a completely assembled vessel ready for installation. Inspection and test reports shall be supplied to customer on Manufacturer's letterhead.
6. Separator shall be cylindrical, horizontal, atmospheric-type steel vessel intended for the separation and storage of flammable and combustible liquids. The separator shall have the structural strength to withstand static and dynamic hydraulic loading while empty and during operating conditions.
7. Separator shall have an oil storage capacity equal to about 50% of the total vessel volume and an emergency oil spill capacity equal to 80% of the total vessel volume.
8. Separator shall consist of inlet and outlet connections, non-clogging flow distributor and energy dissipator device, stationary under flow baffle, presettling chamber for solids, sludge baffle, oil coalescing chamber with parallel corrugated plate and polypropylene coalescers to optimize separation of free oil from liquid carrier, effluent downcomer positioned to prevent discharge of free oil that has been separated from the carrier liquid, access for each chamber, lifting lugs, fittings for vent, oil pump out, sampling, and gauging.

D. General Description

The separator shall be a cylindrical parallel corrugated plate gravity displacement type oil water separator with construction and thickness in strict accordance with Underwriters Laboratories Subject 58, using flat flanged heads. The separator shall be a prepackaged, pre-engineered, ready to install unit consisting of:

1. An influent connection 6 inch, flanged.
2. An internal influent nozzle at the inlet end of the separator, located at the furthest diagonal point from the effluent discharge opening.

3. A velocity head diffusion baffle at the inlet to:
 - reduce horizontal velocity and flow turbulence.
 - distribute the flow equally over the separator's cross-sectional area.
 - direct the flow in a serpentine path in order to enhance hydraulic characteristics and fully utilize all separator volume.
 - completely isolate all inlet turbulence from the separation chamber.
4. A sediment chamber to disperse flow and collect oily solids and sediments.
5. A sludge baffle to retain settleable solids and sediment and prevent them from entering the separation chamber.
6. An Oil Water Separation Chamber containing a parallel corrugated plate coalescer to:
 - shorten the vertical distance than an oil globule has to rise for effective removal.
 - enhance coalescence by generating a slight sinusoidal (wave like) flow pattern thereby causing smaller, slow rising, oil globules to coalesce on the undersides of the plates forming larger, rapidly rising sheets of oil.
 - direct the paths of the separated oil to the surface of the separator.
7. An Oil Water Separation Chamber containing a removable polypropylene coalescer designed to intercept oil globules equal to and greater than 20 microns in diameter to produce an effluent quality of 10 ppm oil and grease.
8. An internal effluent downcomer at the outlet end of the separator, to allow for discharge from the bottom of the separation chamber only.
9. An effluent connection 6 inch, flanged.
10. Fittings for vent, interface/level sensor, and waste oil pump out, sampling, and gauge.
11. Two 24" diameter UL-approved, manholes (18" on 550 gallon), complete with extensions, cover, gasket, and bolts. One manway shall be placed between the inlet and the parallel corrugated plate coalescer to facilitate access into the sediment chamber for solids removal. One manway shall be placed between the parallel corrugated plate coalescer and outlet to facilitate access into the oil water separation chamber for oil removal.
12. Lifting lugs at balancing points for handling and installation.

13. Identification plates: Plates to be affixed in prominent location and be durable and legible throughout equipment life.
14. sti-P3 Corrosion Protection System consisting of:
 - Isolation spool pieces
 - Dielectric isolation gaskets and bushings
 - External surfaces commercially sand-blasted and coated 10 mils on shell, 15 mils on head, DFT Polyurethane or 60, 100 or 125 mils head and shell, Fiberglass Reinforced Polyester
 - Cathodic protection system using zinc anodes
 - PPII Protection Prover
 - sti-P3 Limited 30-year Warranty: Thirty year protection against external corrosion and structural defects.
15. Internal surfaces commercially sand-blasted, coated 15 mils DFT Polyurethane

E. Construction And Materials

Refer to U.L. 58 and sti-P3 Specifications.

F. Quality Assurance

1. Submittals:
 - Shop Drawings: for oil water separators shall show principal dimensions and location of all fittings.
 - Provide three complete sets of installation, operation, and maintenance instructions with separator.
 - Quality control and inspection procedures and reports shall be considered of the submittal package.
2. Warranty
 - The manufacturer shall warrant its products to be free from defects in material and workmanship for a period of one year from the date of shipment. The warranty shall be limited to repair or replacement of the defective part(s). sti-P3 Limited Warranty: Lifetime protection for structural defects. Thirty year protection against external corrosion and structural defects.

G. Approved Manufactures

The Oil Water Separator shown is based on Highland Tank and Mfg. Co., One Highland Road, Stoystown, PA 15563, Phone (814) 893-5701, Facsimile 814-893-6126.

Other Approved manufactures are McTighe Industries, (605)-996-1162; Great Lakes Environmental, (913)-338-0311. Alternate manufacturers may be used only with written prior approval.

H. Accessories

1. Separator furnished with intrinsically safe oil level controls to activate high level alarm at a predetermined oil level. All components enclosed in NEMA enclosure. Panel shall be located at the Pump House and shall include a contact to tie into the DDC Control System Panel.
2. Separator shall be Type II double wall construction with interstitial monitor tied into separator control panel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The complete installation of all piping and tank shall conform to all federal, state and local requirements. Install a monitoring system at each tank. The Contractor shall provide all necessary applications, accessories, and installation requirements to meet all requirements. The Contractor shall prepare application for permit and submit as needed to comply with the regulatory rules.

3.2 PIPE APPLICATIONS

- A. Use black steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger, for piping above grade.
- B. Use Type K, soft temper copper tubing for 2 inch and smaller without joints, for underground installations.
- C. Install underground piping inside a shallow trench with light steel cover.

3.3 PIPE INSTALLATIONS

- A. General: Refer to Division 15 - "BASIC MATERIALS AND METHODS" for basic piping installation instructions.
- B. Make changes in directions and branch connections using fittings.
- C. Make reductions in pipe sizes using eccentric reducer fitting install with the level side down.

- D. Install unions in pipes 2 inch and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- E. Install dielectric unions where piping of dissimilar metals are joined.
- F. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.
- G. Install flexible connectors at inlet and discharge connections to pumps and other vibration producing equipment.
- H. Install strainers on the supply side of each control valve, pressure regulating valve, oil burner connection, and elsewhere as indicated. Install 3/4 inch NPS nipple and ball valve in blow down connection of strainers 2 inch and larger. Use same size nipple and valve as blow-off connection of strainer.
- I. Anchor piping to ensure proper direction of expansion and contraction. Install expansion loops and joints as indicated on the Drawings and specified in Division-15 Section "Expansion Compensation."
- J. Seal pipe penetrations of fire barriers using fire barrier penetration sealers specified in Division-7 Section: "Joint Sealers."
- K. Hanger, supports, and anchors are specified in Division-15 Section "SUPPORTS AND ANCHORS." Conform to the table below for maximum spacing of supports:

1. Steel Pipe:

SIZE (NPS)	SPACING IN FEET	MIN. ROD SIZE-INCHES
1/2 (horizontal)	5	3/8
3/4 to 1-1/4 (horizontal)	5	3/8
1-1/2 to 3 (horizontal)	10	1/2
all sizes (vertical)	every floor level	

2. Copper Tubing:

SIZE (INCH O.D.)	SPACING IN FEET	MIN. ROD SIZE-INCHES
1/2 (horizontal)	4	3/8
5/8 to 1-1/4 (horizontal)	5	3/8
1-1/2 to 2 (horizontal)	5	1/2
all sizes (vertical)	every floor level	

3.4 PIPE JOINT CONSTRUCTION

- A. Welded Joints: Comply with the requirements in ASME Boiler and Pressure Vessel Code, Section IX.
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
 2. CAUTION: Remove stems, seats, and packing of valves, and accessible internal parts of piping specialties before brazing.
 3. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
 4. Heat joints to proper and uniform temperature.
- C. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:
1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 2. Align threads at point of assembly.
 3. Apply appropriate tape or thread compound to the external pipe threads.
 4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.

5. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

3.5 VALVE APPLICATIONS

A. General: The Drawings indicate valve types, locations, and arrangements.

B. General Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:

Shut-off duty: use gate valves

Throttling duty: use globe valves

3.6 VALVE INSTALLATIONS

A. Install valves in accessible locations, protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.

B. Install shut-off duty valves at each branch connection to supply mains, and elsewhere as indicated.

C. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

D. Install swing check valves as required to control flow direction.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sediment Traps: Install a tee fitting with the bottom outlet plugged or capped as close to the inlet of the oil burning appliance as practical. Drip leg shall be a minimum of 3 pipe diameters in length.

B. Veeder Root system shall provide level monitor with high and low level alarm contacts, gallon readout at panel and leak monitoring between tank walls. Alarms shall connect to DDC system.

3.8 FIELD QUALITY CONTROL

- A. Fuel System Test: The entire fuel system shall be tested for leaks after installation and before the underground tank and fittings are covered, and prior to the operational test of the system as hereinafter specified. Fuel piping shall be tested hydrostatically, or with equivalent air pressure, at no less than 1-1/2 times the maximum working pressure but not less than 5 psi in excess of the static pressure produced with the oil level at the highest point of the fuel system. The test shall be made so as not to impose a pressure of more than 10 psi on the tank. In lieu of the pressure test, the suction piping between underground storage tank and fuel pump may be tested under a vacuum of not less than 20 inches of mercury.

The transfer pump discharge piping shall be pressure tested to 225 PSIG.

- B. Test oil piping in accordance with NFPA 31.
- C. Remake leaking joints and connections using new materials.

3.9 COMMISSIONING

- A. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- B. Train Government's maintenance personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance.
- C. Review data in Operating and Maintenance Manuals.
- D. Schedule training with Government through the Contracting Officer's Representative, with at least 7 days advance notice.
- E. Before activating system perform these steps:
 - 1. Open valves to full open position. Close bypass valves.
 - 2. Remove and clean strainer screens.
 - 3. Check pump for proper direction of rotation.
 - 4. Fill oil storage tank with proper fuel type.
 - 5. Check operating controls of fuel burner units.

6. Check operation at automatic bypass valves.
7. Check leak and level monitoring systems for proper operation.

END OF SECTION 15483

SECTION 15488 - NATURAL GAS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Division 1 Specification sections, apply to this section.
- B. The requirements of the following Division 15 Sections apply to this Section:

BASIC MECHANICAL REQUIREMENTS.
BASIC MECHANICAL MATERIALS AND METHODS.
SUPPORTS AND ANCHORS.

1.2 SUMMARY

- A. This Section includes distribution piping systems for natural gas within the building and extending from the point of delivery to the connections with gas utilization devices. Piping materials and equipment specified in this section include:
 - Pipes, fittings, and specialties.
 - Special duty valves.
- B. This Section does not apply to LP-gas piping; industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen; gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.
- C. Gas pressures for systems specified in this section are limited to 5 psig.
- D. Products installed but not furnished under this Section include gas meters which will be provided by the utility company, to the site, ready for installation.
- E. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 2 Section "FUEL GAS SERVICE PIPING" for fuel gas service piping which is underground, outside the building, and connecting the "Gas Distribution Piping" to public utilities (or connecting groups of buildings on the same site).

2. Division 2 Section "EARTHWORK" for trenching and backfilling for installation of gas piping.
3. Division 7 Section "BASIC MATERIALS AND METHODS" for materials and methods for sealing pipe penetrations through basement walls and fire/smoke barriers.
4. Division 15 Section "MECHANICAL IDENTIFICATION" for labeling and identification of gas piping systems.

1.3 DEFINITIONS

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
- B. Gas Distribution Piping: A pipe within the building which conveys gas from the point of delivery to the points of usage.
- C. Gas Service Piping: The pipe from the gas main or other source of supply including the meter, regulating valve, or service valve to the gas distribution system of the building served.
- D. Point of Delivery is the outlet of the service meter assembly, or the outlet of the service regulator (service shutoff valve when no meter is provided).

1.4 SUBMITTALS

- A. Product data for each gas piping specialty and special duty valve. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.
- B. Shop drawings detailing dimensions, required clearances, for connection to gas meter.
- C. Coordination drawings for gas distribution piping systems in accordance with Division 15 Section "BASIC MECHANICAL REQUIREMENTS."
- D. Maintenance data for gas specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 1 and Division-15 Section "BASIC MECHANICAL REQUIREMENTS."
- E. Welders' qualification certificates, certifying that welders comply meet the quality requirements specified under "Quality Assurance" below.
- F. Test reports specified in Part 3 below.

1.5 QUALITY ASSURANCE

- A. **Installer Qualifications:** Installation and replacement of gas piping, gas utilization equipment or accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with precautions required, and has complied with the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.
- B. **Qualifications for Welding Processes and Operators:** Comply with the requirements of ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualification."
- C. **Regulatory Requirements:** Comply with the requirements of the following codes:
 - 1. NFPA 54 - National Fuel Gas Code, for gas piping materials and components, gas piping installations, and inspection, testing, and purging of gas piping systems.
 - 2. UPC Uniform Plumbing Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. **Handling Flammable Liquids:** Remove and legally dispose of liquid from any drips in existing gas piping and handle cautiously to avoid spillage or ignition. Notify the gas supplier. Handle flammable liquids used by the installer with proper precautions, and do not leave on the premises from the end of one working day to the beginning of the next.

1.7 SEQUENCING AND SCHEDULING

- A. **Notification of Interruption of Service:** Except in the case of an emergency, notify all affected users when the gas supply is to be turned off.
- B. **Work Interruptions:** When interruptions in work occur while repairs or alterations are being made to an existing piping system, leave the system in safe condition.
- C. **Coordinate the installation of pipe sleeves for foundation wall penetrations.**

1.8 EXTRA MATERIALS

- A. **Valve Wrenches:** Furnish to Government, with receipt, 2 valve wrenches for each type of gas valve installed, requiring same.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide gas piping system products from one of the following:

Gas Cocks:

Jenkins Bros.
Lunkenheimer Co.
Mueller
NIBCO, Inc.
Powell Co.
Stockham.
Conbraco
Rockwell

2.2 PIPE AND TUBING MATERIALS

- A. General: Refer to Part 3, Article "PIPE APPLICATION" for identification of systems where the below specified pipe and fitting materials are used.
- B. Steel Pipe: ASTM A 120 or A53, Schedule 40, seamless Grade B, black steel pipe, beveled ends.
- C. Plastic Pipe: PE-3406 plastic gas piping conforming to ASTM D2513-73.
- D. Plastic Coated Steel Pipe: X-Tru Coat.

2.3 FITTINGS

- A. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- B. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.
- C. Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets of the following material group, end connection and facing:

Material Group: 1.1.
End Connections: Butt Welding.
Facings: Raised face.

- D. Fittings for Plastic Pipe: Heat fusion or compression fittings with built-in stiffeners and conforming to ASTM D2513-73 or D2517-73.
- E. Fittings for Plastic Coated Steel Pipe: Same as subparagraph B above but wrapped with X-Tru-Tape in conformance with manufacturers instructions.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).
- B. Joint Compound: suitable for the gas being handled.
- C. Gasket Material: thickness, material, and type suitable for gas to be handled, and for design temperatures and pressures.

2.5 PIPING SPECIALTIES

- A. Unions: ANSI B16.39, Class 150 black malleable iron; female pattern; brass to iron seat; ground joint.
- B. Dielectric Unions: ANSI B16.39, Class 250; malleable iron and cast bronze; with threaded or soldered end connections suitable for pipe to be joined; designed to isolate galvanic and stray current corrosion.
- C. Protective Coating: When piping will be in contact with material or atmosphere exerting a corrosive action, pipe and fittings shall be factory-coated with polyethylene tape, having the following properties:
 - overall thickness; 20 mils.
 - synthetic adhesive.
 - water vapor transmission rate,
gallons per 100 square inch: 0.10 or less.
 - water absorption, percent: 0.02 or less.
 - 1. Prime pipe and fittings with a compatible primer prior to application of tape.
- D. Flanges: Use insulating flange gaskets at building shut-off valve and plastic sleeves for the bolts of the flanged connection.

2.6 VALVES

- A. General duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 15 Section "General Duty Valves." Special duty valves are specified in this Article by their generic name. Refer to Part 3 below, Article "VALVE APPLICATION" for specific uses and applications for each valve specified.
- B. Gas Cocks 2 Inch and Smaller: 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends.
- C. Gas Cocks 2-1/2 Inch and Larger: MSS SP-78; 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends.
- D. Solenoid Valves: aluminum body, 120 volts AC, 60 Hz, Class B continuous duty molded coil; NEMA 4 coil enclosure; electrically opened/electrically closed; dual coils; normally closed; UL and FM approved and labeled

2.7 Provide gas meter with pulse indicator output to connect to DDC system.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Conform with the requirements in NFPA 54, for the prevention of accidental ignition.

3.2 PIPE APPLICATIONS

- A. Above Ground Piping:
 - 1. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger.
- B. Below Ground Piping:
 - 1. Install plastic pipe below ground per manufacturer's instructions. Bury with #14 copper tracer wire per code.
 - 2. Transition from plastic pipe to plastic coated steel pipe 10'-0" prior to rising above grade. Continue plastic coated steel pipe above grade to the first shut-off valve.

3.3 PIPING INSTALLATIONS

- A. General: Conform to the requirements of NFPA 54 - National Fuel Gas Code.
- B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Design locations and arrangements of piping take into consideration pipe sizing, flow direction, slope of pipe, expansion, and other design considerations. So far as practical, install piping as indicated.
 - 1. Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction), whether or not such spaces are used as a plenum. Valves shall not be located in such spaces.

Gas piping installed in return air plenums shall be encased in Schedule 10 pipe or round spiral duct sealed tight to prevent any leakage to the return air plenum. Vent the encasement pipe to the exterior or the boiler room.
 - 2. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumb waiter or elevator shaft. This does not apply to accessible above-ceiling space specified above.
- C. Seal pipe penetrations of fire barriers using fire barrier penetration sealers specified in Division 7 Section "Joint Sealers."
- D. Drips and Sediment Traps: Install a drip leg at points where condensate may collect, at the outlet of the gas meter, and in a location readily accessible to permit cleaning and emptying. Do not install drips where condensate is likely to freeze.
 - 1. Construct drips and sediment traps using a tee fitting with the bottom outlet plugged or capped. Use a minimum of 3 pipe diameters in length for the drip leg. Use same size pipe for drip leg as the connected pipe.
- E. Use fittings for all changes in direction and all branch connections.
- F. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- G. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

- H. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building.
- I. Locate groups of pipes parallel to each other with space to permit servicing of valves.
- J. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.
- K. Connect branch outlet pipes from the top or sides of horizontal lines, not from the bottom.
- L. Hanger, supports, maximum support spacing and anchors are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- M. Install unions in pipes 2 inch and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- N. Install dielectric unions where piping of dissimilar metals are joined.
- O. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.
- P. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, and elsewhere as indicated.
- Q. Anchor piping to ensure proper direction of expansion and contraction. Install expansion loops and joints as indicated on the Drawings and specified in Division-15 Section "Basic Mechanical Materials and Methods."
- R. Underground Piping shall rise to above grade before entering building.
- S. Meter and regulator will be installed by the Gas Company. The Mechanical Contractor shall rough-in piping as directed and install shut-off valves. The Gas Company will provide the insulating connection on the outlet side of the meter.

3.4 PIPE JOINT CONSTRUCTION

- A. Welded Joints: Comply with the requirements in ASME Boiler and Pressure Vessel Code, Section IX.
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
 2. CAUTION: Remove stems, seats, and packing of valves, and accessible internal parts of piping specialties before brazing.
 3. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
 4. Heat joints to proper and uniform temperature.
- C. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:
1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint. Refer to NFPA 54, for guide for number and length of threads for field threading steel pipe.
 2. Align threads at point of assembly.
 3. Apply appropriate tape or thread compound to the external pipe threads.
 4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
 5. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
 6. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

3.5 VALVE APPLICATIONS

- A. General: The Drawings indicate valve types, locations, and arrangements.
- B. Shut-off duty: Use gas cocks specified in Part 2 above.

3.6 VALVE INSTALLATIONS

- A. Install valves in accessible locations, protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Install gas cock upstream and within 6 feet of gas appliance. Install a union or flanged connection downstream from the gas cock to permit removal of controls.
- B. Sediment Traps: Install a tee fitting with the bottom outlet plugged or capped as close to the inlet of the gas appliance as practical. Drip leg shall be a minimum of 3 pipe diameters in length.

3.8 ELECTRICAL BONDING AND GROUNDING

- A. Install above ground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 - "National Electrical Code."
- B. Do not use gas piping as a grounding electrode.
- C. Conform to NFPA 70 - "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

3.9 CATHODIC PROTECTION

- A. Steel pipe risers from below grade piping to the gas meter and the building entrance shall be cathodically protected by sacrificial anodes or anodeless riser shall be used.

3.10 FIELD QUALITY CONTROL

Piping Tests:

1. Inspect, test, and purge natural gas systems in accordance with NFPA 54.
2. Underground gas piping shall be tested under 100 psig air pressure.

END OF SECTION 15488

SECTION 15510 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division 1 Specification sections, apply to this section.
- B. The following Division-15 Sections apply to this Section:
 - "BASIC MECHANICAL REQUIREMENTS";
 - "BASIC PIPING MATERIALS AND METHODS";
 - "VALVES";
 - "SUPPORTS AND ANCHORS"

1.2 SUMMARY:

- A. This Section includes piping systems for glycol piping, hot water heating, chilled water cooling, and air conditioning condensate drain piping. Piping materials and equipment specified in this Section include:
 - Pipes, fittings, and specialties;
 - Special duty valves;
 - Hydronic specialties.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 15 Section "BASIC PIPING MATERIALS AND METHODS" for materials and methods for sealing pipe penetrations through basement walls, and fire and smoke barriers.
 - 2. Division 15 Section "GENERAL DUTY VALVES" for gate, globe, ball, butterfly, and check valves.
 - 3. Division 15 Section "METERS AND GAGES" for thermometers, flow meters, and pressure gages.
 - 4. Division 15 Section "MECHANICAL IDENTIFICATION" for labeling and identification of hydronic piping system.

5. Division 15 Section "MECHANICAL INSULATION" for pipe insulation.
6. Division 15 Section "WATER TREATMENT (HVAC)".
7. Division 15 Section "HVAC PUMPS" for pumps, motors, and accessories for hydronic systems.
8. Division 15 Section "DDC CONTROL SYSTEM" for temperature control valves and sensors.
9. Division 15 Section "ADJUSTING AND BALANCING" for procedures for hydronic systems adjusting and balancing.

1.3 DEFINITIONS:

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

1.4 SUBMITTALS:

- A. Product Data: including rated capacities of selected models, weights (shipping, installed, and operating) furnished specialties and accessories, and installation instructions for each hydronic specialty and special duty valve specified.
- B. Certification of compliance with ASTM and ANSI manufacturing requirements for pipe, fittings, and specialties.
- C. Reports specified in Part 3 of this Section.

1.5 QUALITY ASSURANCE:

- A. Regulatory Requirements: comply with the provisions of the following:
 1. ASME B 31.9 "Building Services Piping: for materials, products, and installation.
 2. UMC: Uniform Mechanical Code.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad. Concrete, reinforcement, and formwork requirements are specified in Division 3.

- B. Coordinate the installation of pipe sleeves for foundation wall penetrations.

PART 2 - PRODUCTS

2.1 PIPE AND TUBING MATERIALS:

- A. General: Refer to Part 3 Article "PIPE APPLICATIONS" for identification of where the below materials are used.
- B. Drawn Temper Copper Tubing: ASTM B 88, Type L.
- C. Copper Tubing: ASTM B 88, Type K, annealed copper tubing.
- D. Steel Pipe: ASTM A53 or A120, Schedule 40 Grade B, seamless or ERW, black steel pipe, plain, grooved or beveled ends.
- E. Steel Pipe: ASTM A53, Schedule 40 Grade B, Type F (furnace weld), threaded ends.

2.2 FITTINGS:

- A. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- B. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1. At Contractors option grooved end fittings conforming to above may be used.
- C. Steel Fittings: ASTM A 234, seamless or welded, for welded joints. At Contractors option grooved end fittings conforming to above may be used.
- D. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.
- E. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125; raised ground face, bolt holes spot faced.
- F. Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets of the following material group, end connection and facing:

Material Group: 1.1.
End Connections: Butt Welding.
Facings: Raised face.

- G. Unions: ANSI B16.39 malleable-iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends. Threads shall conform to ANSI B1.20.1.
- H. Dielectric Unions: Threaded or soldered end connections for the pipe materials in which installed; constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.
- I. Grooved Mechanical Fittings: ASTM A 536, Grade 65-45-12 Ductile Iron; ASTM A 47 Grade 325410 Malleable Iron; ASTM A 53, Type F, or types E or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
- J. Grooved Mechanical Couplings: Consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.3 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, 95-5 Tin-Antimony, for heating hot water.
- B. Welding Materials: Comply, with Section II, Part C. ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- C. Gasket Material: Thickness, material, and type suitable for fluid to be handled, and design temperatures and pressures.
- D. Groove type couplings, Victaulic, Gruvlok, or Gustin-Bacon may be used at Contractors option.

2.4 GENERAL DUTY VALVES

- A. General Duty Valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 15 Section "General Duty Valves." Special duty valves are specified below by their generic name; refer to Part 3 Article "VALVE APPLICATION" for specific uses and applications for each valve specified.

2.5 NON-SLAMMING OR SPRING LOADED CHECK VALVES

- A. Types: Provide valves of the fully guided or cone-and-diaphragm types.
- B. Bodies: Provide flanged or wafer type bodies constructed of cast iron ASTM A 126, Class B; cast steel ASTM A 216/A 216M, Class WCB; stainless steel, Type 304 or cast bronze ASTM B 61.
- C. Trim: Seats, discs and springs shall be constructed of 18-8 stainless steel or bronze complying with ASTM B 62. Seats may be of elastomers suitable for 250 degrees F. minimum continuous working temperature or not less than 50 degrees F. above the operating temperature of the system, whichever is higher.
- D. Mating Surfaces: Mating surfaces of closure faces shall be bronze or Type 316 or 17-4PH stainless steel or elastomer approved for the particular service and materials must be compatible to prevent electrolytic action.
- E. Pressure Loss: Pressure loss through the valves, measured in feet of water, shall not exceed 6/10 of the water velocity in feet per second.
- F. Bubble-Tight: Non-slamming and spring loaded check valves shall provide bubble-tight shut-off when handling water up to 250 degrees F. and 125 pounds per square inch differential pressure. Design shall prevent rubbing of seat materials when opening and closing. Poppet valves shall have conical springs.

2.6 STRAINERS

- A. Types: Provide strainers of the "Y" or basket types as indicated on the drawings or required to suit the field conditions.
- B. Strainers 1-1/2-Inch Diameter and Smaller: Provide strainers with bronze bodies conforming to ASTM B 62, Grade C or cast iron bodies conforming to ASTM A 126, Class B.
 - 1. End connections shall be threaded.
 - 2. Screens shall be 18-8 stainless steel with 1/32-inch diameter perforations or openings.

- C. Strainers 2-Inch and Larger: Provide strainers with cast iron bodies conforming ASTM A 126, Class B with flanged end connections.
 - 1. Screens shall be bronze, monel metal or 18-8 stainless steel.
 - 2. Sizes 2-inch to 6-inch shall have 1/16-inch diameter perforations.
 - 3. Sizes 8-inch to 12-inch shall have 1/8-inch diameter perforations.
- D. Design Pressure: Provide strainers designed for 125 pounds per square inch working pressure on systems less than 125 pounds per square inch. Provide 250 pounds per square inch design strainers for systems up to 250 pounds per square inch working pressure.
- E. Strainer Free Area: The free area of each strainer screen shall be not less than three times the area of the strainer inlet pipe.
- F. Drain Valves: For each strainer 1-1/2-inch diameter and larger, provide a plugged minimum 1/2-inch diameter gate or ball valve, bronze body, working pressure to match the strainer, threaded with a plugged outlet.

2.7 BALANCING DEVICES

- A. Wherever "Balance Valves", "Calibrated Balance Valves", or similar words are used on the Contract Drawings, provide bronze or cast iron body brass ball calibrated balance valve with the following features:
 - 1. Differential pressure read-out ports across valve seat fitted with internal check valves.
 - 2. Memory stop to allow valve to be closed for service and then reopened to setpoint.
 - 3. Calibrated scale and integral pointer.
 - 4. Constructed for 125 psig working pressure at a maximum temperature of 250·F.
 - 5. Refer to Section 15135 "METERS AND GAUGES", "Calibrated Balance Valves and Flow Meters".

2.8 EXPANSION TANK: DIAPHRAGM PRE-PRESSURIZED TYPE

- A. Type: Provide pre-pressurized diaphragm-type expansion tanks of sizes indicated on the drawings.
- B. Construction: Construct tanks of steel in accordance with section 8 of the ASME Code for a working pressure of 125 psig. Test and stamp tanks for the working pressure.
- C. Supports: Support tanks on 2-inch diameter steel pipe legs with cross bracing and floor plates or suspend on steel saddles with all-thread rod anchored to the structure.
- D. Manufacturer's Qualifications and Warranty: The tanks shall be the product of a manufacturer who certifies that his tanks have been a standard production model for five years prior to opening bids and warrants the diaphragm material unconditionally, against failure or leakage for a period of five years from the date of project acceptance.

2.9 AIR SEPARATORS

- A. Type: Provide air separators of tangential type constructed of steel and tested and stamped in accordance with section 8 of the ASME Code for a working pressure of 125 psig.
 - 1. Pressure drop through the separator and flow rate shall be as shown on the drawings.
 - 2. Provide separators on hydronic systems capable of separating not less than 80 percent of the entrained air on the first passage of water and not less than 30 percent of residual air on each subsequent passage through the separator.
 - 3. Provide flanged inlet and outlet connections, 3/4-inch diameter valve drain connection and 1-inch diameter top air eliminator connection.
 - 4. Provide 1-inch diameter pipe from the top air eliminator point to a high capacity automatic air vent.
 - 5. Provide 1-inch diameter globe valve between the air separator and the air vent.

2.10 HYDRONIC SPECIALTIES:

- A. Manual Air Vent: bronze body and nonferrous internal parts; 150 psig working pressure, 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; and having 1/8 inch discharge connection and 1/2 inch inlet connection.
- B. Relief Valve: Brass body, EPDM diaphragm and seat, brass internal wetted parts. 3/4" line size. Maximum working pressure of 125 PSI and 250·F. Relief pressure setting as noted on plans.
- C. Pressure Reducing Valve: Cast brass body, diaphragm operated valve seat, strainer, and stem shall be non-corrosive and removable. Removable inlet strainer. Maximum working pressure of 125 PSI. Adjustable pressure range from 10 to 25 PSIG.
- D. Compression and Expansion Tanks: Constructed in accordance with ASME Code for unfired pressure vessel at 125 psi. working pressure - tanks shall bear the ASME label. Gauge glass with stop valves.
- E. Provide industrially inhibited propylene glycol fluid in both hot and chilled water systems. Dowfrost heat transfer fluid or equal.

PART 3 - EXECUTION

3.1 PIPE APPLICATIONS (HOT WATER, CHILLED WATER AND CONDENSER WATER))

- A. At Contractors option in lieu of black steel, install Type L, drawn copper tubing with wrought copper fittings and solder joints for 2 inch and smaller, above ground, within building.
- B. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger. At contractors option, groove joints may be used.

3.2 PIPING INSTALLATIONS

- A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.

- C. Install exposed piping at right angles parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- E. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- F. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- H. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Division 7 for special sealers and materials.
- I. Install piping at a uniform grade of 1 inch in 40 feet upward in the direction of flow.
- J. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.
- K. Install branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line.
- L. Install unions in pipes 2 inch and smaller, adjacent to each valve, at final connections to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- M. Install dielectric unions to join dissimilar metals, including copper coil connections with steel pipe.
- N. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.
- O. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration producing equipment.

- P. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, inline pump, and elsewhere as indicated. Install nipple and ball valve in blow down connection of strainers 2 inch and larger.
- Q. Anchor piping to ensure proper direction of expansion and contraction.

3.3 CONDENSATE DRAIN PIPING (COOLING COIL DRIP)

- A. Condensate Drain Piping shall be Type M copper pipe with sweat fittings or Schedule 40 galvanized steel pipe with screwed fittings.
- B. Pitch all horizontal lines to drain at a minimum fall of 1" per 10 feet of run.
- C. Provide air trap at each equipment connection. Depth of trap shall be sufficient to maintain trap seal with equipment operating.

3.4 HANGERS AND SUPPORTS

- A. General: Hanger supports, and anchors devices are specified in Division 15 Section "SUPPORTS AND ANCHORS." Conform to the table in Section "SUPPORTS AND ANCHORS" for maximum spacing of supports:
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 10 feet in length.
 - 2. Spring hangers to support vertical runs.
- C. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
 - 1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.
 - 2. Fill the pipe and fittings during brazing, with an inert gas (i.e., nitrogen or carbon dioxide) to prevent formation of scale.

3. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.
- C. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:
1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 2. Align threads at point of assembly.
 3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
 4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
 - a. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- D. Welded Joints: Comply with the requirement in ASME Code B31.9 -"Building Services Piping."
- E. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

3.6 VALVE APPLICATIONS:

- A. General Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:
1. Shut-off duty: Use ball, valves for line size 2" and smaller, use butterfly valves above 2" size.
 2. Install shut-off duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.
- B. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

3.7 HYDRONIC SPECIALTIES INSTALLATION:

- A. Install manual air vents at high points in the system, at heat transfer coils, and elsewhere as required for system air venting.

3.8 FIELD QUALITY CONTROL:

- A. Preparation for testing: Prepare hydronic piping in accordance with ASME B 31.9 and as follows:

1. Leave joints including welds uninsulated and exposed for examination during the test.
2. Provide temporary restraints for expansion joints which cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.

- B. Testing: Test hydronic piping as follows:

1. Use clean ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.
2. Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of the liquid.
3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.

4. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 125 PSIG. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength, or 1.7 times the "SE" value in Appendix A of ASME B31.9, Code For Pressure Piping, Building Services Piping.
5. After the hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks. Continue test for 6 hours minimum and re-examine for leaks.

3.9 ADJUSTING AND CLEANING:

- A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.
- B. During flushing use cleaning compounds specified in Section 15704.
- C. The following procedure shall be used for cleaning and flushing of hydronic water piping.
 1. Mix cleaning compound with clean water per chemical manufacturer's instructions and distribute into the chilled water lines.
 2. Completely fill system with water and chemical, and bleed air.
 3. Circulate system for 48 hours. Verify that all valves are open.
 4. Clean strainers a minimum of every 2 hours for the first 4 hours. Then clean every 4 hours, minimum.
 5. Drain water and chemical from piping system. Drain all low points. Allow the drain to bleed while system is circulating and verify proper operation of automatic make-up water valve.
 6. Refill with clean water and circulate for 4 hours using the automatic make-up.

7. Completely drain water from piping system. Drain all low points.
8. Refill with clean water and corrosion inhibitor in quantity as recommended by the chemical manufacturer, based on water samples taken at the site.
9. Test water sample; if test pH exceeds make-up pH continue flushing operation.

3.10 TESTING

- A. 125 Pound Systems: Test hydronic piping subject to main system pressure at not less than 150 pounds per square inch gauge or 1-1/2 times the maximum working pressure devices connected to the piping system, whichever is greater, measured at the low point of the system.
- B. Test Result: After cleaning and filling the mechanical system, operate the system for a period of not less than 48 hours continuously during which time water treatment samples shall be taken at 4 hour intervals and the results plotted on a graph. Testing and sampling shall continue until the graph indicates that the water treatment is maintaining the specified levels of chemical within plus or minus 10 percent under all conditions of load.

3.11 COMMISSIONING

- A. Fill system with clean water, which must be drained in order to make connections for new systems.
- B. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
- C. Before operating the system perform these steps:
 1. Open valves to full open position. Close coil bypass valves.
 2. Remove and clean strainers.
 3. Check pump for proper direction of rotation and correct improper wiring.
 4. Check air vents at high points of systems and determine if all are installed and bleed all air completely from the system.
 5. Set temperature controls so all coils are calling for full flow.
 6. Check operation of automatic bypass valves.

7. Lubricate motors and bearings.
8. After air is eliminated, circulate hydronic water systems for a minimum of 72 hours prior to water balancing.

END OF SECTION 15510

SECTION 15540 - HVAC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 "BASIC MECHANICAL MATERIALS AND METHODS" sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of HVAC pumps work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of pumps specified in this section include the following:
 - Frame-Mounted End Suction.
 - In-Line
- C. Refer to other Division-15 sections for vibration control of HVAC pumps; not work of this section.
- D. Refer to Division-16 sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on pumps. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
 - 2. Interlock wiring between pumps; and between pumps and field-installed control devices.
 - a. Interlock wiring specified as factory-installed is work of this section.
 - 3. Control wiring between field-installed controls, indicating devices, and pump control panels.
 - 4. Control wiring specified as work of Division-16 for Automatic Temperature Controls is work of that section.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of general-use centrifugal pumps with characteristics, sizes and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. HI Compliance: Design, manufacture, and install HVAC pumps in accordance with HI "Hydraulic Institute Standards".
 - 2. UL Compliance: Design, manufacture, and install HVAC pumps in accordance with UL 778 "Motor Operated Water Pumps".
 - 3. UL and NEMA Compliance: Provide electric motors and components which are listed and labeled by Underwriters Laboratories and comply with NEMA standards.
- C. Certification, Pump Performance: Provide pumps whose performances, under specified operating conditions, are certified by manufacturer.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to HVAC pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Maintenance Data: Submit maintenance data and parts lists for each type of pump, control, and accessory; including "trouble- shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Handle HVAC pumps and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged HVAC pumps or components; replace with new.
- B. Store HVAC pumps and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with Manufacturer's rigging and installation instructions for unloading HVAC pumps, and moving them to final location.

PART 2 - PRODUCTS

2.1 PUMPS:

- A. General: Provide factory-tested pumps, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Type, size, and capacity of each pump is listed in pump schedule. Provide pumps of same type by same manufacturer.

2.2 IN THE LINE CIRCULATOR PUMPS:

- A. Manufacturers: Bell and Gossett - Thrush - Taco - Armstrong - Aurora - Amtrol.
- B. Capacity: As scheduled on the plans, see plans for dual pumps.
- C. Features: Centrifugal pump designed especially for in the line application - cast iron volute - steel alloy shaft bronze, sleeve type, bearings - mechanical seal - bronze impeller - oil circulating system - flange connections to piping system - heavy duty open type energy efficient motor.
- D. Accessories: Calibrated balance valve - trumpet valve with pressure gauge piped across pump suction and discharge flanges.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which HVAC pumps are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF PUMPS:

- A. General: Install HVAC pumps where indicated, in accordance with manufacturer's published installation instructions, complying with recognized industry practices to ensure that HVAC pumps comply with requirements and serve intended purposes.
- B. Access: Provide access space around HVAC pumps for service as indicated, but in no case less than that recommended by manufacturer.
- C. Support: Refer to Division-15 section "Vibration Control" for support and mounting requirements of HVAC pumps.
- D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
- E. Piping Connections: Refer to Division-15 HVAC piping sections. Provide piping, valves, accessories, gages, supports, and flexible connections as indicated.
- F. Install horizontal split case pumps and vertical turbine pumps on level concrete pad and grout in place.

3.3 ADJUSTING AND CLEANING:

- A. Alignment: Check alignment, and where necessary, realign shafts of motors and pumps within recommended tolerances by manufacturer, and in presence of manufacturer's service representative.
- B. Start-Up: Lubricate pumps before start-up. Start-up in accordance with manufacturer's instructions. Verify proper rotation and correct accordingly.
- C. Refer to Division-15 section "HVAC Test-Adjust-Balance" for pump system balancing; not work of this section.
- D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 15540

SECTION 15557 - SCOTCH MARINE BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY:

- A. Section includes packaged, factory-assembled and tested, firetube hot water boilers, trim, and accessories.
- B. Related Sections:

Section 15030: Electrical Provisions for Mechanical Work.

Section 15570: Boiler Accessories.

Section 15575: Breechings, Chimneys, and Stacks.

1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model, clearly indicating, dimensions, weights (shipping, installed, and operating), required clearances, furnished specialties and accessories; and installation and start-up instructions.
- B. Shop Drawings: Submit ladder-type wiring diagrams for power and control wiring required for final connections to boilers and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- C. Maintenance Data: Submit maintenance data and parts list for boilers, controls, and accessories; including "trouble-shooting" maintenance guide and preventative maintenance schedule and procedures. Include this data and product data in maintenance manual; in accordance with requirements of Division 1.
- D. Test Report: Submit a factory inspection report prior to shipping.

1.4 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of scotch marine boilers, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Codes and Standards:
1. Boiler testing and rating: in accordance with American Boiler Manufacturer's Association (ABMA) "Packaged Firetube Rating".
 2. Minimum steady state efficiency of boilers: not less than prescribed by ASHRAE 90A "Energy Conservation In New Building Design".
 3. Low pressure boiler construction: in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section IV. Pressure vessel shall bear ASME label.
 4. Control devices and control sequences: Must incorporate all applicable codes, standards, and regulations which are in effect for the contracted site at the time drawings and specification are prepared. Must be interoperable with Base Energy Monitoring and Control Systems to provide needed remote control and monitoring.
 5. Installation standards: Oil-fired boilers shall be in accordance with National Fire Protection Association (NFPA) Standard 31 "Standard for the Installation of Oil Burning Equipment".
 6. Installation standards: Gas-fired boilers shall be in accordance with National Fire Protection Association (NFPA) Code 54 "National Fuel Gas Code".
 7. Ancillary electrical components shall be Underwriters Laboratories (UL) listed and labeled.

Comply with local utility company requirements.
 8. The boiler-burner unit shall carry the Underwriters Laboratory label "B".
 9. The boiler-burner unit shall meet IRI and State requirements.
 10. Installation of the boiler-burner unit shall be to all Michigan and local requirements.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Handle boilers and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged boilers or components; replace with new.
- B. Store boilers and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Rig boilers in compliance with manufacturer's rigging and moving instructions for unloading scotch marine boilers, and moving them to final location.

1.6 SEQUENCE AND SCHEDULING:

- A. Coordinate the size and location of housekeeping concrete pads on which boilers are to be mounted. Coordinate required imbedded anchor devices.
- B. Locate boilers so that front and rear doors may be opened without obstruction, and so that tube pull space is free and clear of all physical obstructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide packaged firetube boilers of one of the following:

Cleaver-Brooks; Div Aqua-Chem, Inc.
Kewanee Boiler Corp.
Superior Boiler Works, Inc.

2.2 PACKAGED FIRETUBE BOILERS:

- A. General Description:
 - 1. Scotch marine boilers shall be factory- assembled and tested, packaged, two or three-pass, horizontal firetube boilers of dry back type. Boilers shall be factory-mounted on heavy steel base frame, complete with integral forced draft burner, burner controls, boiler trim, and refractory. Factory-assemble and wire boilers so that only water, fuel, blowdown, electrical, and vent connections are required. Wet back designs will not be approved.

2. Heating Surface - the boiler shall be designed and constructed with a minimum of 5 square feet of fireside heating surface per boiler horsepower with all heating surface contained in the boiler proper and shall not include any auxiliary equipment such as economizers.
3. The boiler shall be designed, tested and stamped in accordance with ASME Boiler and Pressure Vessel Code Section IV for a MAWP of 30 psig water.
4. Capacities and electrical characteristics are scheduled (on the Drawings).

Provide manufacturer's standard number of handholes in boiler shell, and manhole on boilers over 48" in diameter. Provide 2 lifting lugs, permanently attached to top of boiler.

B. Boiler Design Features:

1. Two pass dry back Scotch Marine type, having a corrugated firetube.
2. The unit shall be of the dryback design with no refractory baffles used to form the passes.
3. Inspection and cleanout openings shall include, in addition to those required by ASME Code, (2) 3 x 4 handholes in the front tube sheet on either side of the corrugated firetube near the bottom of the boiler and a 3 x 4 handhole in the rear tubesheet near the bottom of the boiler. A 16" diameter inspection plug shall allow access to the fireside of the boiler.
4. The boiler shall be mounted on a structural steel base with the base extending beyond the burner to provide support and protection.
5. The entire boiler shell shall be insulated with a minimum of two inch, eight pound density mineral fiber insulation and covered with a 22 gauge phosphate coated steel jacket. All openings in the jacket shall be fitted with cover rings.

- C. Front and rear doors: hinged or davited, sealed with heat resistant gaskets, and fastened with lugs and cap-screws.

Provide observation port for inspection of flame conditions.

- D. Exhaust gas vent: on top of boiler, complete with stack thermometer.

E. Boiler Trim:

1. Pressure gauge with shutoff valve and inspectors gauge cocks.
2. Honeywell RW700/QW700 manual reset low water cutoff.
3. Operating Temperature control.
4. Manual reset high limit temperature control.
5. Modulating firing rate temperature control.
6. Low fire hold control.
7. One slow opening bottom drain valve.
8. The boiler operating controls shall be factory set for an operating temperature of 180 degrees Fahrenheit.
9. Fahrenheit temperature gage: located on front end of boiler. Range shall suit operating temperature.
10. Safety Relief Valves: quantity, type and size to comply with ASME Code requirements.

2.3 FORCED DRAFT BURNER:

- A. The combination natural gas/#2 fuel oil air atomized burner shall be of the annular port flame retention type for natural gas and of the internal mixing multi-jet atomizing nozzle type for #2 oil using air supplied at 60 psig. Burner operation shall be fully modulating with proven low fire start. 4 to 1 turndown ratio for 200 BoHP, and 3 to 1 turndown ratio for 150 BoHP. Gas shall be supplied to the burner at 2.0 PSIG maximum, with full fire operation.
- B. The burner shall incorporate a stainless steel flame retention type combustion head and an external primary-secondary air ratio adjustment in addition to the total air volume adjustment to allow adjustment of the total air volume and primary-secondary air ratio without the dismantling of burner.
- C. The combustion air shall be furnished by the burner fan which shall be an integral part of the burner.

- D. The primary air control louver shall be of the low pressure drop, inlet type and so located to allow visual checking of the outer settings and ease of cleaning and adjustment.
- E. The burner shall be provided with an observation port to allow observation of both the pilot and main flame.

2.4 GAS-ELECTRIC IGNITION SYSTEM

- A. The burner shall have an interrupted gas-electric ignition system with a 6,000 volt ignition transformer and a gas pilot of the premix type with automatic electric ignition. The gas pilot train shall include a shut off cock, gas pressure regulator and automatic gas valve.

2.5 MAIN GAS TRAIN

- A. The main gas train shall meet the requirements of IRI/CSD=1 and shall include a manually operated gas shutoff valve, main gas pressure regulator, main safety shutoff gas valve, 2nd safety shutoff gas valve with proof of closure switch, manually operated leak test valve, (2) manual leak test cocks, manual reset high and low gas pressure switches, characterized fuel metering butterfly valve, gas pressure gauges at the inlet to the gas train and at the burner manifold.

2.6 FUEL OIL SYSTEM

- A. The fuel oil system shall meet the requirements of IRI/CSD-1 and include the air atomizing nozzle, automatic oil safety shutoff valve, 2nd automatic oil safety shutoff valve, oil metering valve, fuel oil filter, oil pressure gauges. Oil shall be supplied to the burner at 80 PSIG.
- B. The oil gun assembly shall be of the quick draw type with burner nozzle and air diffuser location adjustments made without removing the oil gun assembly from the burner, removing the burner from the boiler or without stopping firing of the burner.
- C. The air atomizing supply train shall include a low air pressure switch, air pressure regulating valve, atomizing air pressure gauge and air metering bleed valve. Atomizing air to be provided by the plant air compressor as indicated on the equipment schedule.

2.7 BURNER CONTROLS

- A. The factory wired U.L. labeled control panel shall be mounted on the side of the boiler and shall include control circuit transformer, motor starters, control circuit fuse, numbered terminal strips, "call for heat", ignition, fuel on" and "alarm" lamps, fuel selector switch, manual-auto switch and potentiometer for manual control of the firing rate, electronic safety combustion control.
- B. The electronic safety combustion control shall be A Honeywell BC7895 and shall monitor the ignition, pilot flame and main flame with a scanner to detect ultraviolet radiation.

2.8 SOURCE QUALITY CONTROL:

- A. Boiler shell: designed, constructed, and hydrostatically tested in accordance with ASME Boiler and Pressure Vessel Code; and bearing the appropriate ASME label.

2.9 FACTORY TEST:

- A. The boiler-burner package shall be factory firetested prior to shipment and a copy of the firetest report supplied to the factory authorized service agency providing startup of the unit.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine and verify size, location, and condition of concrete pads upon which boilers are to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. General: Install boilers in accordance with manufacturer's installation instructions, requirements of State and local code and requirements of local Utility Company. Install units plumb and level, to tolerance if 1/8" in 10' in both directions. Maintain manufacturer's recommended clearances around and over boilers.
- B. Support: Install scotch marine boilers on 6" high concrete pad, 6" larger on each side than base of unit. Concrete requirements are specified in Division 3.
- C. Erection: Assemble boiler trim shipped loose or unassembled for shipment purposes. Follow manufacturer's installation instructions.

- D. Gas Piping: Refer to Section 15488 "Natural Gas Systems". Connect gas piping to boiler, full size of boiler gas train inlet, provide union with sufficient clearance for burner removal and service.
- E. Oil Piping: Refer to Section 15483 "Fuel Oil Systems". Connect oil piping to boiler, full size of inlet to burner, provide shutoff valve and union with sufficient clearance for burner removal and service.
- F. Hydronic Piping: Refer to Section 15510 "Hydronic Piping". Connect supply, return, and blowdown boiler tappings as indicated, with shutoff valve and union or flange at each connection.
- G. Breeching: Refer to Section 15575 "Breechings, Chimneys, and Stacks". Connect breeching to boiler outlet, full size of outlet.
- H. Electrical: Refer to Section 16142 "Electrical Connections for Equipment."

3.3 CLEANING:

- A. Flush and clean boilers upon completion of installation, in accordance with manufacturer's instructions.

3.4 FIELD QUALITY CONTROL:

- A. Hydrostatically test assembled boiler and piping in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.
- B. Arrange with Michigan State Boiler Inspector and National Board of Boiler and Pressure Vessel Inspectors for inspection of boiler installation, piping connections, observation of hydrostatic testing, and for certification of completed boiler units.

3.5 DEMONSTRATION:

- A. Services: After testing and inspection is complete, provide the services of an authorized factory service representative to perform start-up and operation demonstration services.
- B. Start-up: Perform services in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment. Each boiler shall be operated on fuel oil for a minimum of 4 hours, and shall demonstrate that full fire and pressure can be obtained on oil firing. Each boiler shall be tested on natural gas at full pressure for a minimum of 4 hours. Boilers shall be operating and at full pressure when the building is turned over to the Owner.

- C. Maintenance and Operation Training: As a part of the maintenance and operating instructions, review data in operating and maintenance manual, including preventative maintenance schedule and procedures, and procedures for obtaining repair parts and technical assistance. Demonstrate all phases of operation including start-up and shut-down.
 - 1. Schedule training with Government, provide at least 7-day notice to Contracting Officer's Representative.

END OF SECTION 15557

SECTION 15570 - BOILER ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of boiler accessories work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of boiler accessories specified in this section include the following:
 - 1. Safety and relief valves.
 - 2. Boiler Sequencing Control.
- C. Refer to other Division-15 sections for boilers, piping, specialties, concrete pads, etc., required for installation of boiler accessories; not work of this section.
- D. Refer to Division 16 Sections for the following work: Not work of this Section.
 - 1. Power supply wiring from power source to power connection on control panel and damper actuators.
 - 2. Interlock wiring between boilers and accessories.

1.3 QUALITY ASSURANCE:

- A. Manufacturers Qualifications: Firms regularly engaged in manufacture of boiler accessories, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. ASME Compliance: Construct and install boiler accessories in accordance with ASME "Boiler and Pressure Vessel Code". Install boiler accessories in accordance with ASME B31.1 "Power Piping", or ASME B31.9 "Building Services Piping", as applicable.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating where applicable), furnished specialties and accessories; and installation and start-up instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data and parts lists for each boiler accessory, including "troubleshooting" maintenance guide. Include this data and product data in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 SAFETY AND RELIEF VALVES:

- A. Safety Valves: Provide safety valves as indicated, of size and capacity as selected by Installer for proper relieving capacity, constructed in accordance with ASME Boiler and Pressure Vessel Code.
- B. Cast-Iron Safety Valves: Construct of cast iron, with all bronze/brass trim, and fully enclosed spring. Set valve to relieve at 10 PSI above operating pressure.
- C. Manufacturer: Subject to compliance with requirements, provide steam safety valves of one of the following:

Kunkle Valve Co., Inc.
Lunkenheimer (The) Co.,; Div. of Conval Corp.
Spirax Sarco, Inc.
Watts Regulator Co.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which boiler accessories are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 INSTALLATION:

- A. Install boiler accessories as indicated, in accordance with manufacturer's installation instructions, and with recognized industry practices, to ensure that boiler accessories comply with requirements and serve intended purposes. Comply with requirements of state and local boiler codes, applicable portions of ASME Boiler and Pressure Vessel Code, and applicable portions of ASME B31.1 or ASME B31.9.
- B. Coordinate with other work as necessary to interface installation of boiler accessories with other components of heat generation systems.
- C. Coordinate wiring requirements for boiler accessories with Electrical Contractor.

3.3 SAFETY AND RELIEF VALVES:

- A. Safety Valves: Install as indicated on top of boilers. Pipe discharge to floor drain.

3.4 FIELD QUALITY CONTROL:

- A. Flush and clean boiler accessories upon completion of installation, and in accordance with manufacturer's installation instructions.
- B. Hydrostatically test, if required, assembled boiler accessories and piping in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.

END OF SECTION 15570

SECTION 15575 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.

1.2 RELATED SECTIONS:

- A. Refer to other sections of Division 15 for insulation of breechings, chimneys, and stacks.
- B. Refer to other sections of Division 15 for fuel burning equipment, draft hoods, and accessories associated with fuel burning equipment.

1.3 SUMMARY:

- A. This Section specifies double wall metal vents and accessories for gas-fired appliances. Use positive pressure double wall vents for boilers, make-up air unit. Use type B gas vents for gas fired furnaces and unit heaters. Boiler double wall metal vents shall be suitable for oil firing.

1.4 SUBMITTALS:

- A. Product Data: Submit product data including materials, dimensions, weights, and accessories.
- B. Shop Drawings: Submit shop drawings including required clearances, assembly and installation instructions, and support of components.
- C. Quality Control Submittals:
 - 1. Certificates: Submit certificates of materials compliance with specified ASTM, UL, and ASHRAE requirements.
 - 2. Certificates: Submit complete engineering report certifying that stacks meet the design wind and seismic loads.

1.5 QUALITY ASSURANCE:

A. Codes and Standards:

1. UMC: Uniform Mechanical Code.
2. NFPA: Comply with NFPA 211 "Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances."
3. UL: Comply with applicable portions of UL safety standards; provide products which have been UL listed and labeled.
4. SMACNA: Comply with SMACNA Low Pressure Duct Standards for fabricated breeching and smokepipe.
5. ASHRAE: Comply with the ASHRAE Equipment Handbook, Chapter 27, for Chimney, Gas Vent, and Fireplace Systems, material requirements and design criteria.

PART 2 - PRODUCTS

2.1 DOUBLE WALL METAL VENTS:

A. Type B Gas Vents:

1. Available Manufacturers: Subject to compliance with requirements, provide Type B double wall gas vents of one of the following:

Metalfab
Hart & Cooley Mfg. Co.
Selkirk Metalbestos.

2. Description: Double wall gas vents, UL listed for Type B, consisting of an inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, with the following minimum thicknesses:

<u>Size</u>	<u>Inner Pipe</u>	<u>Outer Pipe</u>
Round, up to 6"	0.012"	28 gage
Round, 7" to 18"	0.014"	28 gage
Round, 20" to 24"	0.018"	26 gage
Oval, up to 4"	0.012"	28 gage
Oval, 5" to 6"	0.014"	28 gage

3. Accessories: UL-labeled tees, elbows, increasers, draft hood connectors, metal cap with bird barrier, adjustable roof flashing, storm collar, support assembly, thimbles, fire stop spacers, and fasteners, fabricated of similar materials and designs as vent pipe straight sections.

B. All Steel, Positive Pressure, Double Wall Vents:

1. Manufacturers: Subject to compliance with requirements, provide all steel, positive pressure double wall vents of one of the following:

Metalfab
Selkirk Metalbestos.
Van Packer
Stacks, Inc., Div of Air Management, Inc.

2. Description: UL-labeled double wall metal stacks for use with building heating equipment burning gas, solid, or liquid fuels as described in NFPA 211.

3. Construction: 1" minimum air space between walls; inner jacket of Type 316 stainless steel, 0.035" thick; outer jacket of aluminum coated steel of the following thickness:

Size 10" to 24": 0.025" thick.
Size 28" to 48": 0.034" thick.

4. The portion of the high pressure boiler flue vent pipe which is located inside the building shall have 1" thick insulation within the annular space between the dual wall vent pipes.
5. The portion of the emergency generator diesel exhaust pipe which is located inside the building shall have 2" thick insulation within the annular space between the dual wall vent pipes.
6. The insulation shall be a fiber type 6 pounds per cubic foot, thermally stable and corrosion resistant.
7. The insulated and non-insulated pipe and accessories shall be listed as a U.L. system for 1000°F continuous operation and intermittent operation (1 hour or less) of 1400°F.

8. Accessories: UL-labeled tees, elbows, increasers, draft hood connectors, metal cap with bird barrier, adjustable roof flashing, storm collar, support assembly, thimbles, fire stop spacers, and fasteners fabricated of similar materials and designs as vent pipe straight sections.

PART 3 - EXECUTION

3.1 INSTALLATION OF DOUBLE WALL CONNECTORS, BREECHINGS, AND VENTS:

- A. Install Type B gas vents in accordance with manufacturer's installation instructions and UL listing. Maintain minimum clearances from combustibles specified in UL listing.
- B. Install all steel, positive pressure, double wall gas vents in accordance with manufacturer's installation instructions and UL listing. Maintain minimum clearances from combustibles specified in UL listing.
- C. Seal joints between sections of positive pressure vents in accordance with manufacturer's installation instructions, and using only sealants recommended by manufacturer.
- D. Support vents at intervals recommended by the manufacturer to support the weight of the vent and all accessories, without exceeding loading of appliances.

3.2 ADJUSTING AND CLEANING:

- A. Clean breechings internally during installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth.

3.3 PROTECTION:

- A. Temporary Closure: At ends of breechings and chimneys which are not completed or connected to equipment, provide temporary closure which will prevent entrance of dust and debris until installations are completed.

END OF SECTION 15575

SECTION 15620 - FUEL-FIRED HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of fuel-fired heater work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of fuel-fired heaters specified in this section include the following:
 - Gas-Fired Make-Up Air Unit (Direct Fired)
 - Gas Unit Heaters
- C. Refer to appropriate Division-15 sections for fuel piping; controls, ductwork; breechings; and testing, adjusting, and balancing in connection with fuel-fired heaters; not work of this section.
- D. Refer to Division-16 sections or the following; not work of this section.
 - 1. Power supply wiring from power source to power connection on fuel-fired heaters. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
- E. Interlock wiring between fuel-fired heaters; and between fuel-fired heaters and field-installed control devices.
- F. Interlock wiring specified as factory-installed is work of this section.
- G. Refer to other Division-15 sections for automatic temperature controls not factory-installed, required in conjunction with fuel-fired units; not work of this section.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. ANSI Compliance: Construct and install gas-fired unit heaters in accordance with ANSI Z83.8 "Gas Unit Heaters".
2. NFPA Compliance: Install fuel gas piping and gas-fired heaters in accordance with NFPA 54 "National Fuel Gas Code".

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type show drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring for fuel-fired heaters. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Maintenance Data: Submit maintenance data and parts list for each type of fuel-fired heater, control, and accessory; including "trouble-shooting" maintenance guide. Include this data and product data in maintenance manual; in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING:

- A. Handle fuel-fired heaters and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged fuel-fired heaters or components; replace with new.
- B. Store fuel-fired heaters and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with Manufacturer's rigging and installation instructions for unloading fuel-fired heaters, and moving them to final location.

PART 2 - PRODUCTS

2.1 MAKE UP AIR UNIT (DIRECT FIRED)

- A. Manufacturers: Hastings, King, Aerovent, Reznor or approved equal.
- B. Capacity: As scheduled on drawings.
- C. General: Heater shall be shop assembled and wired complete with burner, fan and motor assembly, structural reinforced sheet metal casing, controls and safety devices, factory flame tested and shipped as a complete UL approved package assembly. Designed for natural gas firing. Unit shall be specifically designed for horizontal outdoor installation. AGA design certified.
- D. Equipment Casing and Base:
 - 1. Casing shall be industrial quality welded construction of 10 gauge hot rolled steel primed inside and out with outside surface finished with coat of enamel. Observation port provided..
 - 2. Access panels shall be provided to allow easy access to motors, filters and electrical controls.
 - 3. Casing shall have a rinse primer and an enamel finish.
 - 4. Base frame channels shall be constructed of a 1/4" hot rolled steel base frame.
- E. Blower Section:
 - 1. Blower wheels shall be statically and dynamically balanced forwardly curved double width double inlet Class 1.
 - 2. Blower wheels shall be mounted on a solid turned ground shaft with keyway for driven sheave.
 - 3. Bearings shall be ball bearing self-aligning, permanently lubricated. Provide extended grease lines, for ease of maintenance.
 - 4. Blower scrolls, bearings, and adjustable motor base shall be mounted and properly reinforced to insure rigidity and quiet operation.
 - 5. Cabinet shall be of 10 gauge hot rolled steel with a primed and enamel finish.

6. The driver and driven sheaves shall be of the keyed hub type. The driven sheave shall be of a fixed pitch diameter and the driver shall be a variable pitch diameter sheave. V-belt drives shall be sized for 150% of motor horsepower.
- F. Furnace Section:
1. Burners shall be direct gas fired line burner suitable for complete combustion of natural gas with 30:1 turndown ratio.
 2. Burner tray shall be so constructed as to slide out from compartment for easy service and maintenance.
 3. Gas and electrical components shall consist of not less than the following: main gas cock, main gas pressure regulator, main solenoid gas valve, pilot gas cock, pilot gas pressure regulator, pilot solenoid gas valve, intermittent spark ignition system, high limit control and 24 volt control transformer. Manifold controls may be in combination.
 4. Combustion controls shall meet I.R.I. requirements, Honeywell BC7895.
 5. Temperature controls consist of modulating gas valve which modulates down to 30:1 turndown ratio and maintains desired leaving air temperature. Provide discharge air temperature sensor. Provide with remote control station with operating switches and indicating lights. Solid state electronic modulation, provides constant leaving air temperature. A temperature selector mounted in the control cabinet permits adjustment of leaving air temperature from a convenient location. Low outlet temperature safety shut-off to de-energize fan if discharge air drops to 40°F. Inlet sensor shall shutdown burner when outdoor air is above 55°F.
 7. Control cabinet shall be suitable for hazardous locations..
- G. Motor: A two speed T-frame, ODP, 1800/900 RPM prefabricated ball bearing type high efficiency motor shall be furnished for voltage as scheduled.
- H. Filters: Provide with filter box two complete sets of filters. See Filter Section of Specifications.
- I. Provide with integral fused disconnect switch, and motor starter.
- J. Provide services of factory authorized representative for start-up and check-out of make-up air unit.

2.2 GAS-FIRED UNIT HEATERS, SEPARATED COMBUSTION

- A. Comply with AGA Z83.8, "Gas Unit Heaters."
 - 1. AGA Approval: Bear label of American Gas Association.
 - 2. Type of Gas: Natural.
- B. Assembly and Wiring: Heaters factory assembled, piped, wired, and tested for 120 VAC.
- C. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
 - 1. External Casings and Cabinets: Baked enamel over corrosion-resistant-treated surface.
- D. Heat Exchanger: Aluminized steel.
- E. Burners: Cast iron or aluminized steel with stainless-steel inserts.
- F. Power Venter: 120 VAC with stainless-steel shaft.
- G. Concentric, Terminal Vent Assembly: Combined combustion-air inlet and power-vent outlet. Include adapter assembly for connection to inlet and outlet pipes, and flashing for wall or roof penetration.
- H. Unit Fan Type: Centrifugal fan, factory balanced, resilient mounted, steel, belt driven with adjustable-pitch motor sheave.
 - 1. Motors: Totally enclosed with internal thermal overload protection and complying with Division 15 Section "Motors."
- I. Automatic Gas Control: 2-stage, 24 VAC valve.
 - 1. Ignition: Electronically controlled spark with flame sensor.
- J. Discharge Louvers: Independently adjustable horizontal blades.
- K. Accessories: Furnish the following accessories for field assembly:
 - 1. Vertical discharge louvers.
 - 2. Summer fan switch.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which fuel-fired heaters are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF GAS-FIRED MAKE-UP AIR UNIT HEATERS:

- A. General: Install gas-fired make-up air unit as indicated, and in accordance with manufacturer's published installation instructions.
- B. Extend gas piping to within 5' from unit, provide drop with manual gas shutoff valve, 1/8" NPT plugged test connection, tee, and drip pocket. Locate piping drop so as to not interfere with service of unit. Extend gas piping runout, full size of gas train inlet, from tee to gas train connection, provide union with sufficient clearance for unit removal and service.
- C. Electrical wiring is specified in Division 16, not work of this section.
- D. Install clean filters prior to air balancing. Unit shall not be operated unless filters are in place.

3.4 START-UP:

- A. Start-up, test, and adjust fuel-fired heaters in accordance with manufacturer's published start-up instructions. Adjust air diffusion louvers for proper air flow. Verify proper line and manifold gas pressure. Check and calibrate controls, adjust burner for maximum efficiency.

END OF SECTION 15620

SECTION 15684 - RECIPROCATING OR SCROLL WATER CHILLERS-AIR COOLED

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Chiller package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Unit mounted starters.
- F. Electrical power connections.

1.2 RELATED SECTIONS

- A. Section 15510 - Hydronic Piping.
- B. Section 15950 - Automatic DDC Temperature Controls.
- C. Section 16120 - Wires and Cables
- D. Refer to Division 16 sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on unit. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed by manufacturer.
- E. Provide the following electrical work as work of this sections, complying with requirements of Division 16 sections:
 - 1. Control wiring between field-installed controls, indicating devices, and unit control panels.
 - a. Control wiring specified as work of Division 15 for Automatic DDC Temperature controls is work of that section.

1.3 REFERENCES

- A. ANSI/ASHRAE STANDARD 15-1978 - Safety Code for Mechanical Refrigeration.
- B. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.
- C. ANSI/ASME SEC VIII - Boiler and Pressure Vessel Code.
- D. ANSI/UL 465 - Central Cooling Air Conditioners.
- E. UL 984 - Safety Standards for hermetic motor compressors.
- F. ANSI/ASME B31.S-1983 ASME Code for pressure piping and refrigeration piping.
- G. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings. Bearings must have life of not less than 200,000 hours.

1.4 SUBMITTALS

- A. Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- B. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams. Submit certification of compliance with ASME, UL and ASHRAE.
- C. Submit manufacturer's installation instructions.
- D. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to chiller. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation data.
- B. Include start-up instructions, maintenance data, controls, and accessories. Include trouble-shooting guide.
- C. Submit maintenance data and parts list.
- D. Include this data, product data, shop drawings and wiring diagrams in maintenance manual.

1.6 REGULATORY REQUIREMENTS

- A. Conform to ARI Standard 550-88 code for rating and testing of reciprocating and rotary chillers.
- B. Conform to ANSI/UL 465 for construction of chillers and provide UL label.
- C. ARI Std. 590, "Standard for Reciprocating Water Chilling Packages."

1.8 HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage and from weather. Leave factory shipping covers in place until installation.
- C. Store chillers in clean, dry, place and protect from construction traffic.

1.9 WARRANTY

- A. Provide one year warranty.
- B. Warranty: Include coverage for complete chiller package as manufactured and delivered to site including materials and labor.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of chillers for period of one year from Date of Substantial Completion

PART 2 - PRODUCTS

2.1 SUMMARY

- A. The contractor shall furnish and install are reciprocating or scroll water chillers as shown and scheduled in the plans. The units shall be installed in accordance with this specification and produce the specified tonnage per the scheduled data in accordance with ARI 550-88. The unit shall bear the ARI certification label as applicable.
- B. Approved manufacturers:
 - 1. Trane:
 - 2. Carrier:
 - 3. York: Product YT.
 - 4. McQuay.
- C. If the chiller provided does not operate on R-22, the chillers supplied shall be capable of operating on refrigerant R-123 or 134.

2.2 COMPRESSOR AND MOTOR

- A. Compressor Features: Hermetic or serviceable hermetic with the following options:
 - 1. Vibration isolators to isolate compressors.
 - 2. Crankcase heater.
 - 3. Oil strainer.
 - 4. Oil sight glass.
 - 5. Oil filling connection.
 - 6. Reversible, positive-displacement oil pump.
 - 7. Oil filter with magnetic plug.
 - 8. Suction and discharge line service valves.
- B. Refrigerant: R-22 (HCFC-22); full operating charge of refrigerant and oil.
- C. Cooler: Direct-expansion shell and tube cooler with the following features:
 - 1. Refrigerant totally enclosed in the tubes; water enclosed by the shell.
 - 2. Seamless copper tubes expanded into tube sheets, with the following internal finish:
 - a. Internal Finish: Ribbed.

3. Removable carbon-steel heads.
 4. Baffle to ensure oil return.
 5. Refrigerant Working Pressure: 225 psig (1560 kPa).
 6. Water-Side Working Pressure: 300 psig (2070 kPa).
- D. Insulation: Factory-insulate cooler, suction lines, and other surfaces where condensation might occur with flexible elastomeric insulation of the following thickness:
1. Thickness: 3/4 inch (19 mm).
- E. Air-Cooled Condenser: Include the following features:
1. Coils: Seamless copper tubing mechanically jointed to aluminum fins.
 - a. Factory leak-test coils.
 - b. Minimum Test Pressure: 425 psig (2930 kPa).
 2. Fans: Direct drive, statically and dynamically balanced, with fan guards.
 3. Fan Motor: 3-phase, inherent overload protection, permanently lubricated bearings.
- F. Exterior Casing: Manufacturer's standard equipment casing with the following features:
1. Coated with corrosion-resistant exterior finish.
 2. Removable doors or panels for service and inspection of components.
 3. Tamperproof guards.
- G. Refrigerant Circuit Accessories: Include the following:
1. Solenoid valve in each liquid line.
 2. Filter/dryer for each circuit with replaceable core.
 3. Sight glass and moisture indicator in each liquid line.
 4. Thermal-expansion valve for each circuit.
 5. Manual shutoff in each liquid line.
 6. Refrigerant charging connection for each circuit.
- H. Control Panel: Include the following control features:
1. Low-oil-pressure protection.
 2. Evaporator-freeze protection.
 3. Return-chilled-water-temperature controller.
 4. Chilled water flow protection.
 5. Condenser water flow protection.
 6. Load limiting.

7. Lead/lag compressor sequencing.
8. Low-ambient-temperature head-pressure control.
9. Low-ambient-temperature time delay.
10. Low-refrigerant-pressure protection.

I. Chiller Options: Include the following:

1. Automatic pump down.
2. Hot gas bypass.
3. Control transformer.
4. Electric heat-tracing on cooler.

J. Motor-Protection Features: Include the following:

1. Compressor overcurrent protection.
2. Compressor thermal-overload protection.
3. Single-phasing protection.

K. Power Controls: Combination controller and disconnect with across-the-line start.

1. External overload protection.
2. Control circuit fuse.
3. Power terminal block.

L. Vibration Control: Direct isolation (no base) and vibration isolators recommended by manufacturer.

1. Vibration Isolators: Rubber mounts (Type 2) suitable for exterior installation, minimum deflection of 0.25 inch (6 mm).

2.5 CONTROLS

- A. The chiller(s) shall be controlled by a stand-alone Direct Digital Control (DDC) System. A dedicated chiller control panel is to be supplied with and mounted on each chiller by the chiller manufacturer. The panel shall be microprocessor-based, with factory packaging and testing of all required control components for reliable equipment operation.
- B. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays and switches. The panel shall be a complete system for stand-alone chiller control and includes controls to safely and efficiently operate the chiller. In addition a remote display shall be provided and installed in the mechanical room by TCC panels.

- C. Safeties - The chiller control panel shall monitor such safeties as motor starting and running, time between compressor/motor starts, low chilled water temperature, high condenser refrigerant pressure, low evaporator refrigerant temperature, evaporator and low oil pressure, high oil temperature, and proper operation of unit controls and sensors.
- D. The chiller control panel is to be provided with the following dial type pressure gauges:
 - 1. Evaporator refrigerant pressure
 - 2. Condenser refrigerant pressure
- E. The chiller control panel is to be provided with a starts counter and running time meter.
- F. The front of the chiller control panel shall be capable of displaying the following:
 - 1. Entering and leaving evaporator water temperature
 - 2. Chilled water setpoint
 - 3. Electrical current limit set point
 - 4. Chiller operating mode
 - 5. Chiller diagnostic codes
- G. The chiller control panel shall provide evaporator freeze protection and low limit control. This control shall be used to avoid low evaporator refrigerant temperature tripouts during critical periods of chiller operation. The control shall take progressively more aggressive load limiting action in response to the severity of the rate of change and the actual value of the evaporator refrigerant temperature. A diagnostic code, reflecting the operating status, shall be automatically displayed at the front panel whenever this control is in effect.
- H. The chiller control panel shall provide an alarm relay output that shall energize whenever a fault requiring manual reset is detected by the panel.
- I. The chiller control panel shall provide condenser limit control to include a pressure transducer and interconnecting piping and wiring. This control shall be used to avoid high condenser refrigerant pressure tripouts during critical periods of chiller operation. The control shall take progressively more aggressive load limiting action in response to the severity of the rate of change and actual value of the condenser refrigerant pressure. A diagnostic code, reflecting the operation status, shall be automatically displayed at the front panel whenever this control mode is in effect.

- J. The chiller control panel shall provide leaving chilled water temperature reset for each individual chiller based upon ambient temperature using a linear ramp as follows:

	Chiller
Ambient	Leaving CWS Temp.
90° or Above	44° F
70° F or Less	46° F

- K. Unit shall have following contacts for interface to DDC system: external auto/stop; chilled waterflow interlock; external chilled water setpoint to accept 4-20 mA control signal from DDC system..
- L. Include with this work the total cost of material and labor for any control wiring associated with the control panel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service. Include for connection of oil pump to separately fused circuit.
- C. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit.
- D. Furnish and install necessary auxiliary water piping and valves for oil cooling units and purge condensers. Connect to domestic cold water system, and chilled water system.
- E. Arrange piping or each dismantling to permit tube cleaning.
- F. Provide piping from chiller rupture disc to outdoors. Size as recommended by manufacturer.
- G. Install plumb and level, firmly secured to vibration isolators.
- H. Install chilled water flow switch, install water temperature sensors and wells.
- I. Install resistoflex R6904 molded teflon, isolators with Monel reinforcing ring and flange connections mounted on both inlet and outlet of evaporator and condenser. Equal by EGC Style M-149.

3.2 MANUFACTURER'S FIELD SERVICES.

- A. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s). Representatives shall provide leak testing, evacuation, dehydration, and charging of the unit(s). Chiller manufacturers shall maintain service capabilities no more than 250 miles from jobsite.
- B. A start-up log shall be furnished by the manufacturer to document the chiller's start-up date and shall be signed by the Contracting Officer's representative prior to commissioning the chillers.
- C. The manufacturer shall furnish complete submittal wiring diagrams of the centrifugal chiller(s) starter(s) and associated components like pumps, interlocks, etc. as applicable. The chiller manufacturer shall submit these wiring diagrams to the Temperature Control Contractor (T.C.C.) for incorporation into an overall control wiring diagram for the chiller systems. The T.C.C. overall control wiring diagram shall then be reviewed by the Chiller Manufacturer.
- D. Train the Government's maintenance personnel on start-up and shut-down procedures, trouble shooting, and servicing procedures. Schedule training with Contracting Officer's Representative 7 days in advance. Training shall be provided by the Mechanical Contractor and a factory Authorized Representative.

END OF SECTION 15684

SECTION 15704 - WATER TREATMENT (HVAC)

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Cleaning and treatment of circulating HVAC water systems.
 - 1. Cleaning compounds.
 - 2. Chemical treatment for closed loop heat transfer systems.

1.2 RELATED WORK:

- A. Section 15010, BASIC REQUIREMENTS (MECHANICAL).
- B. Section 15050, BASIC MECHANICAL MATERIALS AND METHODS.
- C. Section 15510, HYDRONIC PIPING SYSTEMS.

1.3 QUALITY ASSURANCE:

- A. Refer to paragraph, QUALITY ASSURANCE in Section, BASIC REQUIREMENTS (MECHANICAL).
- B. Technical Services: Provide the services of an experienced water treatment chemical engineer or technical representative to direct flushing, cleaning, pre-treatment, training, debugging, and acceptance testing operations; direct and perform chemical limit control during construction period and monitor systems for a period of 12 months after acceptance, including not less than four service calls and written status reports. Minimum service during construction/start-up shall be eight hours.

1.4 SUBMITTALS: In accordance with Section , SAMPLES AND SHOP DRAWINGS, furnish the following:

- A. Manufacturer's Literature and Data:
 - 1. Cleaning compounds and recommended procedures.
 - 2. Chemical treatment for all systems.

- B. Water analysis verification and report.
- C. Materials Safety Data Sheet for all proposed chemical compounds, based on U.S. Department of Labor Form NO. L5B-005-4, May 1969.
- D. Maintenance and operating instructions in accordance with “GUARANTEE”.

1.5 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

- A. National Fire Protection Association (NFPA):

NFPA.....National Electric Code

- B. U.S. Department of Labor:

Form No. L58-005-4 (May 5, 1969), Materials Safety Data Sheet.

PART 2 - PRODUCTS

2.1 CLEANING COMPOUNDS

- A. Alkaline phosphate or nonphosphate detergent/surfactant/specific to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and like deleterious substances, with or without inhibitor, suitable for system wetted metals without deleterious effects.
- B. Refer to Section, HYDRONIC PIPING SYSTEMS, PART 3, for flushing and cleaning procedures.

2.2 CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS

- A. Inhibitor: Provide sodium silicate, sodium nitrite/borate, or other approved proprietary compound suitable for make-up quality and make-up rate and which will deter bacteria/corrosion problems or mechanical seal failure due to excessive total dissolved solids. Shot feed manually. Maintain inhibitor residual as determined by water treatment laboratory, taking into consideration residual and temperature effect on pump mechanical seals.

- B. pH Control: Inhibitor formulation shall include adequate buffer to maintain pH range of 8.0 to 10.0.
- C. Performance: Protect various wetted, coupled, materials of construction including ferrous, and red and yellow metals. Maintain system essentially free of scale, corrosion, and fouling. Corrosion rate of following metals shall not exceed specified mills per year penetration; ferrous, 0.5; brass, 0.2; copper, 0.15. Inhibitor shall be stable at equipment skin surface temperatures and bulk water temperatures of, respectively, not less than 250 and 125 degrees Fahrenheit. Heat exchanger fouling and capacity reduction shall not exceed that allowed by fouling factor 0.0005.
- D. Pot Feeder: By-pass type for chemical treatment schedule 10 gauge heads, 3/4-inch system connections and large neck opening for chemical addition. Feeders shall be five gallon minimum size for hot water heating systems and five gallon for chilled water systems.
- E. Provide one years supply of chemicals.

2.3 CHEMICAL FEEDING AND CONTROL EQUIPMENT - CHILLED WATER SYSTEM AND HOT WATER SYSTEM

- A. For each hot and chilled water system, the contractor shall install a One-Shot Feeder with funnel and air release valve having a minimum of five gallon capacity and be designed to meet the pressure requirements of the system.

2.4 WATER TREATMENT CHEMICALS - CHILLED WATER SYSTEM AND HOT WATER SYSTEM

- A. Furnish one year's supply of the recommended chemical formulas for scale and corrosion protection of closed recirculation system. Formulation shall not contain any ingredients which are harmful to system materials of construction.

2.5 TESTING EQUIPMENT

- A. Furnish basic water test equipment, including carrying case and spare reagent for maintaining control of program standards in the condenser, hot and chilled water systems. Test kits will include the following:
 - 1. Reagents and apparatus for determination of corrosion inhibitor level in the condenser, hot and chilled water system.
 - 2. Reagents and apparatus for determination of pH, P & M alkalinity and chlorides.
 - 3. Apparatus for determination of microbiological colony population and biocide effectiveness.

2.6 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Section, BASIC METHODS AND REQUIREMENTS (MECHANICAL).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Delivery and Storage: Deliver all chemicals in manufacturer's sealed shipping containers. Store in designated space and protect from deleterious exposure and hazardous spills.
- B. Install equipment furnished by the chemical treatment supplier and charge systems according to the manufacturer's instructions and as directed by the Technical Representative.
- C. Perform tests and report results in accordance with Division 1 requirements.
- D. Instruct Government's personnel in system maintenance and operation in accordance with Division 1 requirements.

3.2 WATER TREATMENT SERVICE PROGRAM

- A. The water treatment company shall provide all consulting services for a period of one year from start-up of the water treatment system which will include:
 - 1. Installation and system start-up procedure recommendations.
 - 2. Pre-operation system cleanout procedure supervision.
 - 3. Initial water analysis and recommendations.
 - 4. Training of operating personnel on proper feeding and control techniques.
 - 5. Periodic field service and consultation meetings.
 - 6. Any necessary log sheets and record forms.
 - 7. Any required laboratory and technical assistance.

END OF SECTION 15704

SECTION 15755 - HEAT EXCHANGERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of heat exchangers work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of heat exchangers required for project include the following:
 - 1. Hot water pre-heat coil.
 - 2. Electric Steam Humidifier
- C. Refer to other Division-15 sections for insulation of heat exchangers; not work of this section.
- D. Refer to other Division-15 sections for piping, valves, specialties, and controls required in conjunction with heat exchangers; not work of this section.
- E. Refer to Division-16 sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on terminal unit. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
 - 2. Interlock wiring between electrically-operated terminal units; and between terminal units and field-installed control devices.
 - a. Interlock wiring specified as factory-installed is work of this section.

- F. Provide the following electrical work as work of this section, complying with requirements of Division-16 sections:
1. Control wiring between field-installed controls, indicating devices, and terminal unit control panels.
 2. Control wiring specified as work of Division 15 for Automatic Temperature Controls is work of that section.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. ASME Compliance: Construct heat exchangers in accordance with ASME Boiler and Pressure Vessel Code, Section VIII "Pressure Vessels", Division 1.
2. TEMA Compliance: Construct and install heat exchangers in accordance with "Standards of the Tubular Exchanger Manufacturers Association".

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's specifications for equipment including performance data, materials, dimensions, weight, required clearances, and installation data. Submit Manufacturers' Data Report for Pressure Vessels, Form U-1, as required by provisions of ASME code rules.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data and parts list for each type of heat exchanger. Include this data in maintenance manual.
- D. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to terminal units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING:

- A. Handle heat exchangers carefully to prevent damage, breaking, denting, and scoring. Do not install damaged units or components; replace with new.

- B. Store heat exchangers in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with manufacturer's rigging and installation instructions for unloading heat exchangers, and moving them to final location.

PART 2 - PRODUCTS

2.1 HUMIDIFIER INDIRECT ELECTRIC TO STEAM

- A. Manufacturer: Armstrong, Dri-Steam or approved equal.
- B. Capacity: As scheduled on the plans.
- C. Features: Unit shall consist of an enclosed, corrosion-resistant, stainless-steel evaporating chamber with heliarc welded seams.
- D. Cleanable Design: Vaporizing chamber cover and/or front clean-out plate shall be easily removable for access to the vaporizing chamber for physical removal of mineral buildup.
- E. Immersion Heater(s): Heater(s) shall be INCOLOY alloy sheathed resistance type heater(s) designed for up to 90 watts per square inch. They shall be threaded and screwed into the front face plate of the vaporizing chamber thus providing for convenient removal for inspection.
- F. Electronic Water Level Control: Electronic water level control system shall provide for automatic refill, low water cut off and skimmer blow down functions. System shall consist of:
 - 1. A water level sensing unit comprise of three TEFLON coated stainless steel probes screwed into a threaded probe head. Probe head shall incorporate probe isolation skirts and be mounted on the face plate of the vaporizing chamber,
 - 2. A solenoid operated fill valve factory mounted on the face plate.
 - 3. A solid state electronic logic control module mounted and wired in the control panel.
- G. Surface Skimmer: Surface skimmer shall be provided which is field adjustable to provide for optimum mineral removal with minimum water waste.

- H. Humidifier body shall be factory insulated with 3/4" rigid foam insulation covered with reinforced aluminum foil.
- I. The steam shall be admitted to the air stream by means of 1 1/2" diameter steam hose and dispersion tube.
- J. Unit shall have multiple dispersion tubes as shown on drawings, with drain line at the end of the dispersion tube. The Contractor shall extend the drain line to the floor drain.
- K. Tube bank shall consist of a horizontal header and necessary quantity of vertical dispersion tubes necessary to achieve the required steam absorption distance. Header shall span the width of the duct, be constructed of stainless steel and be fitted with 1 1/2" tee outlets for dispersion tube connections. The dispersion tubes shall extend the height of the duct and shall be fitted with two rows of high temperature VALOX inserts arranged in a V-pattern. Each insert shall extend through and into the center of the dispersion tube and incorporate a properly sized calibrated orifice.
- L. Provide unit with automatic drain with timer, air flow proving switch, high limit duct humidistat.
- M. SCR Controller (full modulation): A 100% solid state, power controller shall be mounted and wired in the control cabinet. A compatible humidistat shall be shipped loose for field installation. System shall modulate humidifier output from 0% to 100% of maximum capacity.
- N. Control Cabinet: Control cabinet shall be UL Listed and shipped loose for field installation. Sub-panel shall be enclosed in a UL Listed JIC enclosure and contain magnetic contractor(s), control circuit transformer, multiple heater fuses, logic control system module, numbered terminal strip and all interconnecting wiring.
- O. Install per manufacturer's instructions.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which heat exchangers are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 STEAM HUMIDIFIERS:

- A. General: Install as indicated and specified herein and in accordance with manufacturers instructions.
- B. Install dispersion tubes in duct and seal airtight at duct wall.
- C. Point dispersion nozzles up for steam to steam humidifier, when installed in high velocity duct.
- D. Mount humidifier heat exchanger using angle iron brackets.
- E. Piping: Provide steam humidifier piping and water piping as indicated including shut-off valve.
- F. Controls: Provide and mount panel controls.
- G. Electrical: Install electrical control panels and provide electrical contractor with wiring diagram.

3.3 ADJUSTING AND CLEANING:

- A. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint. Clean or vacuum coils of all construction dirt and debris.

END OF SECTION 15755

SECTION 15855 - AIR HANDLING UNITS AND CABINET FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of air handling unit work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of packaged air handling units required for project include the following:
 - Indoor blow-through
 - Indoor draw-through
 - Cabinet fans
- C. Refer to Division-16 sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on unit. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed by manufacturer.
- D. Provide the following electrical work as work of this section, complying with requirements of Division-16 sections:
 - 1. Control wiring between field-installed controls, indicating devices, and unit control panels.
 - a. Control wiring specified as work of Division-15 for Automatic Temperature Controls is work of that section.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards.
2. ARI Compliance: Test and rate air handling units in accordance with ARI 430 "Standard for Central-Station Air Handling Units".
3. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".
4. UL and NEMA Compliance: Provide electrical components required as part of air handling units, which have been listed and labeled by UL and comply with NEMA Standards.
5. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for air handling units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials, and installation instructions.
- B. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air handling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- C. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals; in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver air handling units with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.
- B. Handle air handling units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to air handling unit manufacturer.
- C. Store air handling units in clean dry place and protect from weather and construction traffic.
- D. Comply with manufacturer's rigging and installation instructions for unloading air handling units, and moving them to final location.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide air handling units of one of the following:

Air Handling Units and Cabinet Fans:

Carrier Air Conditioning
McQuay Inc.; Air Conditioning Div.
Trane Co.
York

Computer Room Air Conditioners:

Liebert
Data Aire

2.2 AIR HANDLING UNITS AND CABINET FANS:

- A. General: Provide factory-fabrication and factory-tested air handling units or cabinet fans as indicated, of sizes and capacities as scheduled, and as specified herein. Units shall be no larger in physical size than that shown on drawings. The units shall be furnished complete with centrifugal or plug fan (as indicated on drawings), coils, high efficiency motor, belt drive with guard, insulated casing, and insulated drain pan. U.L. Listed.

- B. Casings: Construct casings of 16-ga minimum mill galvanized or painted steel, designed to withstand specific operating pressures. Provide casing panels and/or access doors that are easily and quickly removable for inspection and access to internal parts. Reinforcing members shall be 12-gauge. At manufacturers option casings may be insulated double-wall panels provided that is a standard product of the manufacturer.
- C. Modular unit shall be constructed of a complete frame with removable panels. Removal of side panels must not affect the structural integrity of each module. The casing must be able to withstand up to six-inches positive or four-inches negative static pressure. All exterior wall panels shall be made of minimum 18-gauge G90 galvanized steel. Closed-cell foam gasketing shall be where modules are joined.
1. Provide single zone units consisting of fan section, coil section, adjustable fan motor mounting, and drain pan.
 2. Provide multizone units consisting of single zone components, diffuser section, damper section, zoning dampers, and balancing plate when required to equalize resistances through cooling and heating passes.
 3. Provide reinforced points of support for either setting or hanging units.
 4. Provide insulated, coated, and sloped drain pan, located under cooling coil section extensive enough to catch condensate leaving coil at highest catalogued face velocity. Horizontal draw thru units shall have drain pan under both fan and coil sections. Provide drain connection on one side at low point in drain pan.
 5. Cover casing and frame with protective finish on both sides.
 6. The fan and coil section shall be internally insulated.
 7. All panels shall be sealed with closed-cell foam gasketing.
 8. Units shall ship fully assembled (within freight limitations on a minimum 10-gauge galvanized steel base rail housekeeping pad, 8" high.)
 9. Unit shall be double-wall constructed to prevent fiberglass erosion into the airstream and to allow cleaning of the unit interior. Interior wall shall be two-inches thick of 20-gauge solid galvanized steel. Foil faced insulation is not acceptable.
 10. Fan modules shall be double wall constructed to prevent fiberglass erosion into the airstream and to allow cleaning of the unit interior. Interior wall shall be four-inches thick of 18-gauge perforated galvanized steel. Foil faced insulation is not acceptable.

- C. Coils: Provide heating and cooling coils of scheduled capacity, mounted in unit in manner permitting removal. Coils shall be a product of the Unit Manufacturer. Coil selection shall be based on a .0005 fouling factor. Coils shall be certified as complying with ARI Standard 410.
1. Construct coils with copper tubing primary surface and configured aluminum secondary surface bonded to tubes by method approved by specified manufacturer. Provide chilled water and heating coils with threaded connections. Provide water coils with drain and vent connections. All water coils shall be 100% drainable. Coils shall be pressure tested to 200 PSIG and proof tested to 300 PSIG.
 2. Tubes shall be round 1/2" or 5/8" OD with wall thickness of .020" minimum. Tubes shall be mechanically bonded into small grain, grey, cast iron headers or round copper headers.
 3. Coil performance shall be verified by computer print-out submitted with shop drawings.
 4. All coils shall be enclosed in a coil section. Coil headers and U-bends shall not be exposed.
 5. Water flow shall be counter to airflow.
- D. Coil Sections: Provide common or individual casing for heating and cooling coils as required. Design internal structure of coil section to allow for removal of coils, and provide suitable baffles to assure no air bypass around coils. Provide condensate pans and drain connections to cooling coil sections of sufficient size to contain and remove coil condensate. Insulate coil section casings and drain pans as specified in "Insulation" paragraph.
- E. Not Used.
- F. Fan Sections:
1. Centrifugal fans shall be double width, double inlet centrifugal type backward inclined, forward curved, or air foil fans specifically designed and suitable for class of service indicated.
 2. Housed fan performance shall be certified as complying with ARI Standard 430-89. Centrifugal fans shall be dynamically balanced at the factory as a complete fan assembly (fan wheel, motor, drive and belts). Fan shafts shall not exceed 75 percent of their first critical speed at any cataloged rpm.

3. Provide grease lubricated fan bearings with externally accessible fittings for lubrication. Statically and dynamically balance fan assemblies in fan housing after final assembly.
 4. Pulleys and belts shall be designed and selected for 150% of motor horsepower. Provide adjustable pitch pulley permitting fan speed to be varied.
 5. The fan shall be capable of operating at the minimum CFM stated on the plans without surge or cavitation. Provide insulated hinged access door in the fan section.
 6. Fans shall be equipped with self-aligning, anti-friction split pillow block bearings with a minimum life of 200,000 hours. (L-50 400,000 hours)
 7. At manufacturer's option fan and motor assembly shall be internally isolated from unit casing with spring isolators, furnished and installed by unit manufacturer. Fan scroll shall be attached to the unit casing by a flexible canvas duct. Otherwise the entire AHU shall be mounted on spring isolators.
 8. Motors shall be mounted integral to an isolated fan assembly furnished by the unit manufacturer. Motors shall be mounted inside or outside the unit casing. Motors shall be mounted on a slide base to permit adjustment of drive belt tension. Motors shall be energy efficient type.
- G. Filter Boxes: Provide filter boxes with either hinged access doors or quickly removable panels, at each end. Provide racks to receive 2" thick filters in angle type pattern. Maximum filter velocity at rated CFM shall not exceed 350 feet per minute.
- H. Insulation: Insulate unit casing from air entrance to mixing box, to air outlet from unit, including bypass duct if used. Insulate framing angles exposed to air stream. Securely attach insulation, of 1" thickness 1.5 pound density to prevent condensation from forming on unit casing. Protect insulation against deterioration from air currents by providing a neoprene coating on the insulation.
1. Provide insulation with fire-retarding characteristics, complying with NFPA 90A. Insulate drain pans as required to prevent condensate formation on unit exterior at ambient conditions to be encountered.
 2. Double-wall units shall be factory insulated with 1 1/2 pound density insulation. All connecting channels shall be insulated to prevent sweating.

- I. Mixing Boxes: Provide mixing boxes of physical size to match basic unit, and include equal-sized flanged openings capable of handling full air flow. Arrange openings as indicated. Provide dual action opposed blade dampers with sealing edges, arranged to operate automatically with one set of linkage. Provide dampers of balanced construction, rotating in sintered bronze or nylon bearings. Dampers shall be ultra low-leak with maximum leakage of 10 CFM per square foot of damper area at one-inch W.G. pressure differential.
- J. Air Filters: Provide two complete sets of air filters to fit in filter box. Install second set of clean filters in unit immediately prior to air balancing the system. Do not run units unless filters are in place.
 - 1. Disposable Type: Provide disposable type air filters 2" thick, U.L. Class 2 consisting of viscous coated fibers with filtering media encased in fiberboard cell sides having perforated metal grids on each side to provide media support.
 - a. Provide filters with clean resistance not exceeding 0.10" w.g. at face velocity of 300 fpm, and ASHRAE weight arrestance efficiency of 70-82%, based on final operating resistance of 0.5" w.g.
 - b. Filters shall be pleated type similar to FARR 30/30.
 - 2. Provide diaphragm-type filter gage for each filter bank, with dial and pointer, graduated to read from 0 to 2" w.g.
 - 3. Provide pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which air handling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF AIR HANDLING UNITS AND CABINET FANS:

- A. General: Install air handling units and cabinet fans where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

- B. Coordination: Coordinate with other work, including ductwork, floor construction, roof decking, and piping, as necessary to interface installation of air handling units with other work.
- C. Access: Provide access space around air handling units for service as indicated, but in no case less than that recommended by manufacturer.
- D. Mounting: Mount air handling units on vibration isolators, in accordance with manufacturer's instructions. Refer to Section 15200.
- E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
- F. Piping Connections: Refer to Division-15 HVAC sections. Provide piping, valves, accessories, gages, supports, and flexible connectors as indicated.
- G. Duct Connections: Refer to Division-15 Air Distribution sections. Provide ductwork, accessories, and flexible connections as indicated.
- H. Grounding: Provide positive equipment ground for air handling unit components.
- I. Install air filter gage pressure taps upstream and downstream of filters to indicate air pressure drop through air filter. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level inclined gages if any, for proper readings. Install tubing and gage so that it clears the filter access door.

3.3 FIELD QUALITY CONTROL:

- A. Testing: Upon completion of installation of air handling units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

3.4 EXTRA STOCK:

- A. Provide one complete extra set of filters for each air handling unit. Install new filters at completion of air handling system work, and prior to testing, adjusting, and balancing work.

END OF SECTION 15855

SECTION 15870 - POWER AND GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of power and gravity ventilator work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of power and gravity ventilators required for project include the following:
 - Louvers
 - Roof or Wall Mounted Exhaust Fans/Relief Fans
 - Roof or Wall Mounted supply fan.
 - Propeller Fans
 - In-Line Fans
 - Roof Hoods; Relief or Intake
- C. Refer to Division-15 section "Testing, Adjusting, and Balancing" for balancing of power and gravity ventilators; not work of this section.
- D. Refer to Division-15 temperature control systems sections for control work required in conjunction with power and gravity ventilators; not work of this section.
- E. Refer to Division-16 sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on ventilators. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

2. Interlock wiring between ventilators; and between ventilators and field-installed control devices.
 - a. Interlock wiring specified as factory-installed is work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms listed below that are regularly engaged in manufacture of power and gravity ventilators, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Codes and Standards:
 1. AMCA Compliance: Provide louvers, power ventilators and penthouses which have been tested and rated in accordance with AMCA Standards, and bear AMCA Certified Ratings Seal.
 2. UL Compliance: Provide power ventilators which are designed, manufactured, and tested in accordance with UL 705 "Power Ventilators".
 3. NEMA Compliance: Provide motors and electrical accessories complying with NEMA standards.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data for power and gravity ventilators, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions.
- B. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to power ventilators. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- C. Maintenance Data: Submit maintenance data and parts list for each type of power and gravity ventilator, accessory, and control. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 ROOF AND WALL MOUNTED EXHAUST FANS/RELIEF FANS:

- A. General: Except as otherwise indicated, provide standard prefabricated power ventilator units of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation.
- B. Centrifugal Fans: Provide centrifugal roof type, curb mounted, power ventilators of type, size, and capacity as scheduled, and as specified herein.
 - 1. Type: Centrifugal fan, direct or belt driven as scheduled. Provide spun aluminum, weatherproof housings. Provide square or rectangular base to suit roof curb. Provide permanent split-capacitor type motor for direct driven fans; capacitor-start, induction-run type motor for belt driven fans.
 - 2. Electrical: Provide factory-wired non-fusible type disconnect switch at motor in fan housing. Provide thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection.
 - 3. Bird Screens: Provide removable bird screens, 1/2" mesh, 16- ga aluminum or brass wire.
 - 4. Dampers: Provide gravity-actuated louvered backdraft dampers in curb bases, unless motor operated damper is specified on the drawings. Dampers shall not be installed at kitchen hood exhaust fans.
 - 5. Kitchen hood exhaust fans shall be up blast, vertical, discharge type. The fan, and wheel inlet, and housing shall be all aluminum. Construction shall include built-in grease drain. Motor and drive shall be out of the air stream, with an intake air breather tube extending to an outside location free of discharge containments. Entire drive assembly shall be mounted on rubber vibration isolators. Unit shall be AMCA approved for sound and air performance.
- C. Filters: Provide throwaway filter in supply fan housing, where noted on drawings.
- D. Drives: Pulleys and belts for belt drive units shall be designed and selected for 150% (minimum) of the motor horsepower. Adjustable sheave. Belt guard.
- E. Wall Propeller Fan: Steel propeller, belt drive, steel casing. Penn breezeway or approved equal by manufacturers listed.
- F. In-Line Fan: Centrifugal, steel casing, integral backdraft damper. Penn, Zephyr or approved equal by manufacturers listed.

G. Manufacturers: Penn, Cook, Greenheck, Jenn Air.

2.2 LOUVERS

A. Manufacturers: Ruskin ELF 375DD or equal as manufactured by American Warming - Airstream - Louvers and Dampers - Dowco - Industrial Louvers.

B. Stationary extruded aluminum with flattened 3/4" x .051" aluminum bird screen. See Architectural for special shape louvers.

C. 4" deep frame of 6063T5 aluminum 0.10" wall thickness with downspouts and caulking slots.

D. Combustion air louvers shall have 1/4" mesh galvanized screen.

E. Blades at approx. 3" centers with .081" wall thickness.

F. Set in openings, caulk and connect the ductwork where applicable.

G. Finish: Louvers shall receive Kynar finish color coating applied following a thorough cleaning, pretreatment, and prime coating. Cleaning shall include complete submersion in an acid cleaner, an alkali cleaner, an acid deoxidation, an amorphous chrome phosphate conversion coating, and an acidulated final rinse. Louvers shall be dried before application of final finish. Kynar shall be applied to provide a dry thickness of approximately 1.2 mils when baked at 450°F. for 10 minutes. Color shall be selected by the Architect.

H. Drainable blade type construction.

I. Provide multiple sections as required to accommodate overall size specified.

J. Louvers installed in precast walls shall not have a flange frame.

K. Louvers installed in metal panel walls shall have a flange frame.

2.3 VANE-AXIAL FANS

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

- B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.
- C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

Service Factor: 1.5.

Belts: Oil-resistant, non-sparking, and non-static.

Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.

Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.

- D. Shaft Bearings: Provide type indicated, having a median life "Rating Life" (AFBMA L50) of 200,000, calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

- E. Factory Finish: The following finishes are required:

Sheet Metal Parts: Prime coating prior to final assembly.

Exterior Surfaces: Baked-enamel finish coat after assembly.

- F. VANE-AXIAL FANS

1. General Description: Belt-driven or direct-drive as indicated, variable pitch or adjustable pitch as indicated, vaneaxial fans consisting of fan wheel and housing, straightening vane section, factory-mounted motor, an inlet cone section, and accessories.

2. Housings: Steel housing, 14-gage minimum, with inlet bell and diffuser sections.

Inlet and Outlet Connections: Outer mounting frame and companion flanges; inlet cone shall be welded to the fan raceway.

Guide Vane Section: Integral guide vanes downstream of the fan wheel designed to straighten the airflow.

3. Wheels: Cast-aluminum, axial-flow type, with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid steel key.

4. Fan Hub and Blade Bearing Assemblies: Cast aluminum, machined and fitted with threaded bearing wells to receive blade bearing assemblies.

Blades: Replaceable, cast aluminum; factory-mounted and balanced to the hub assembly.

Fan Shaft: Turned, ground, and polished steel.

Shaft Bearings: Grease-lubricated, self-aligning, pillow block type; tapered roller bearings with double-locking collars and two-piece, cast-iron housing.

5. Direct-Drive Units: Motor encased in housing out of air stream, factory-wired to disconnect located on outside of fan housing.

6. Belt-Drive Units: Provide enclosure around belts and sheaves.

Motor Mounting: Adjustable base.

Sheaves: Adjustable.

Belts: Oil-resistant, non-sparking, and non-static.

7. Accessories: The following accessories are required as indicated:

Companion Flanges: Rolled-steel flanges.

Inlet and Outlet Screens: Heavy wire mesh inlet screens on fans not connected to ductwork.

Backdraft Dampers: Butterfly-style, for mounting and flexible connection to the discharge of the fan, or direct-mounted to the discharge diffuser section.

8. Motors:

Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.

Motor Sizes: Minimum sizes and electrical characteristics as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range.

Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).

Bearings: The following features are required:

Ball or roller bearings with inner and outer shaft seals.

Grease lubricated.

Designed to resist thrust loading where belt drives or other drives product lateral or axial thrust in motor.

Enclosure Type: The following features are required:

Open drip-proof motors where satisfactorily housed or remotely located during operation.

Guarded drip-proof motors where exposed to contact by employees or building occupants.

Overload protection: Built-in, automatic reset, thermal overload protection.

Noise rating: Quiet.

Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, Test Method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors" in accordance with IEEE Standard 112, Method B.

Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.

Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 16.

2.4 LOUVERS

- A. Manufacturers: Ruskin ELF 375DD or equal as manufactured by American Warming - Airstream - Louvers and Dampers - Dowco - Industrial Louvers.
- B. Stationary extruded aluminum with flattened 3/4" x .051" aluminum bird screen. See Architectural for special shape louvers.
- C. 4" deep frame of 6063T5 aluminum 0.10" wall thickness with downspouts and caulking slots.
- D. Combustion air louvers shall have 1/4" mesh galvanized screen.
- E. Blades at approx. 3" centers with .081" wall thickness.
- F. Set in openings, caulk and connect the ductwork where applicable.
- G. Finish: Louvers shall have mill finish.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. General: Examine areas and conditions under which power and gravity ventilators are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF ROOF MOUNTED FANS:

- A. General: Except as otherwise indicated or specified, install ventilators in accordance with manufacturer's installation instructions and recognized industry practices to insure that ventilators serve their intended function. Install exhaust fan so that it may be removed for access to the dampers.
- B. Coordinate ventilator work with work of roofing, walls, and ceilings, as necessary for proper interfacing.
- C. Ductwork: Refer to Division-15 section "Ductwork". Connect ducts to ventilators in accordance with manufacturer's installation instructions.

1. Solder bottom joints and up 2" of side joints of duct under roof ventilator to retain any moisture entering ventilator.
- D. Roof Curbs: shall be provided as noted on drawings, or herein.
- E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Verify proper rotation direction of fan wheels. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
- F. Remove shipping bolts and temporary supports within ventilators. Adjust dampers for free operation.
- G. Installation of kitchen hood exhaust ducts and fans shall comply with the requirements of the 1988 Uniform Mechanical Code Chapter 20.

3.3 INSTALLATION OF LOUVERS

- A. Install in wall openings provided by General Contractor. Coordinate opening sizes with General Contractor and/or Building Manufacturer.
- B. Rigidly attach to structure using tamperproof fasteners and connect to ductwork where applicable.
- C. Install caulking and sealant between louver frame and wall.
- D. Install dampers and security bars as indicated on drawings.
- E. Install louvers in precast walls in accordance with the Architectural detail for standard window installation in a precast wall.

3.4 FIELD QUALITY CONTROL:

- A. Testing: After installation of ventilators has been completed, test each ventilator to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

3.5 ADJUSTING AND CLEANING:

- A. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 15870

SECTION 15885 - AIR CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of air cleaning work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of air cleaning equipment specified in this section include the following:
 - 1. Air Filters
Replaceable (throwaway).
 - 2. Filter Gages.
- C. Refer to Division-15 air handling units section for filter boxes and filters associated with air handling units; not work of this section.
- D. Refer to Division-15 duct accessories section for duct-access door work required in conjunction with air filters; not work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air cleaning equipment of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. NFPA Compliance: Comply with applicable portions of NFPA 90A and 90B, and NEC pertaining to installation of air filters and associated electric wiring and equipment.
2. UL Compliance: Comply with UL Standards pertaining to safety and performance of air filter units.
3. ASHRAE Compliance: Comply with provisions of ASHRAE Standard 52 for method of testing, and for recording and calculating air flow rates.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data including, dimensions, weights, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, fire classification, and installation instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for filter rack assemblies indicating dimensions, materials, and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data and spare parts lists for each type of filter and rack required. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide air treatment equipment of one of the following:

American Air Filter Co., An Allis-Chalmers Co.
Barnebey-Cheney Co.
Cambridge Filter Corp.
Continental Air Filters Co.
Farr Co.
Flanders Filters, Inc.
Research Products Corp.

2.2 AIR FILTERS:

- A. Replaceable (Throwaway) Filters: Provide medium efficiency, pleated, disposable type filters consisting of nonwoven cotton and synthetic fabric media, media support grid, and enclosing frame. Filter shall be U. L. Listed Class 2 with average media efficiency of 25-30% for 2" filters and 20% for 1" filters on ASHRAE Test Standard 52-76 and average arrestance of 90-92% for 2" filters and 85% for 1" filters in accordance with test standard. Media support grid shall be a welded wire grid with an effective open area not less than 96%. Support grid shall be bonded to filter media and formed in such a manner that it effects radial media pleat design, allowing total use of filter media. Enclosing frame shall be constructed of a rigid, heavy-duty, high wet-strength beverage board, with diagonal support members bonded to the air entering and air exiting side of each pleat. The inside periphery of the enclosing frame shall be bonded to the filter pack, eliminating air bypass. Provide 1" thick filters for fan terminal units and fan coil units. All other filters shall be 2" thick. Farr 30/30 or equal for 2" filters, Farr 20/20 or equal for 1" filters initial resistance for 2" filters @ 500 fpm shall not exceed .28" W.G. Initial resistance for 1" filters @ 500 fpm shall not exceed .26" W.G.

2.3 FILTER GAGES:

- A. Provide diaphragm-type filter gage for each air handling unit and make-up air unit filter bank, with dial and pointer, graduated to read from 0 to 2" w.g.
 - 1. Provide pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which air filters and filter housings will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION:

- A. General: Comply with installation requirements as specified elsewhere in these specifications pertaining to air filters housings/casings and associated supporting devices.
- B. Install air filters and holding devices of types indicated, and where shown; in accordance with air filter manufacturer's written instructions and with recognized industry practices; to ensure that filters comply with requirements and serve intended purposes.

- C. Locate each filter unit accurately in position indicated, in relation to other work. Position unit with sufficient clearance for normal service and maintenance. Anchor filter holding frames securely to substrate.
- D. Coordinate with other work including ductwork and air handling unit work, as necessary to interface installation of filters properly with other work.
- E. Install filters in proper position to prevent passage of unfiltered air.
- F. Install air filter gage pressure tips upstream and downstream of filters to indicate air pressure drop through air filter. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level inclined gages if any, for proper readings. Install piping and gauge so as not to obstruct access doors.

3.3 FIELD QUALITY CONTROL:

- A. Operate installed air filters to demonstrate compliance with requirements. Test for air leakage of unfiltered air while system is operating. Correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with retesting.

3.4 EXTRA STOCK:

- A. Provide one complete extra set of filters for each air handling system, fan coil system, fan terminal system, and make-up air system. If system is designed to include pre-filters and after-filters, provide only pre-filters. Install the extra set of new filters at completion of work, and prior to testing, adjusting, and balancing work. Obtain receipt from Government that new filters have been installed.

END OF SECTION 15885

SECTION 15891 - METAL DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.
- B. Refer to other Division-15 sections for ductwork accessories; not work of this section.
- C. Refer to other Division-15 sections for fans and air handling units; not work of this section.
- D. Refer to other Division-15 sections for testing, adjusting, and balancing of metal ductwork systems; not work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.
- C. Codes and Standards:
 - 1. SMACNA Standards: Comply with 1985 Edition, SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
 - 2. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.

3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".

D. Field Reference Manual: Have available at project site field office, copy of "SMACNA HVAC Duct Construction Standards 1985 Edition.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

B. Record Drawings: At project closeout, submit record drawings of installed ductwork, duct accessories, and outlets and inlets; in accordance with requirements of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchase products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS:

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains and discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality, with G 60 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations.

- C. All round ductwork both high velocity and low velocity shall be machine made spiral duct, constructed per SMACNA with not less than 26 gauge galvanized sheet metal.

2.2 MISCELLANEOUS DUCTWORK MATERIALS:

- A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment. Round ductwork shall be minimum of 26 gauge.
- B. Fittings: For round ductwork provide radius type fittings fabricated of multiple sections with maximum 15 deg change of direction per section. Unless specifically detailed otherwise, use 45 deg laterals and 45 deg elbows for branch takeoff connections. Where 90 deg branches and takeoffs are indicated, provide conical type tees.
- C. Duct Liner: Fibrous glass, complying with Thermal Insulation Manufacturers Association (TIMA) AHC-101; of thickness indicated in Insulation Section of Specifications.
- D. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation".
- E. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.
- F. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.
- G. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.
- H. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

- I. Flexible Ducts: Either spiral-wound spring steel with flameproof vinyl sheathing, or corrugated aluminum; complying with UL 181.
 - 1. Provide 1" thick continuous flexible fiberglass sheath with vinyl vapor barrier jacket.

2.3 FABRICATION:

- A. Shop fabricate ductwork in 4, 8, or 10 foot lengths, unless otherwise indicated or required to complete runs. Pre-assemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.
- B. Shop fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards", 1985 Edition. Unless noted otherwise on the drawings, supply ductwork at air handling units and make-up air units shall be constructed for 3" static pressure. Exhaust and supply ductwork after fan powered terminal units shall be constructed for 2" static pressure. Return, and fresh air ductwork shall be fabricated for (NEG.) 1.0 static pressure. Reinforcement spacing shall be 5' maximum.
- C. Seal all transverse joints, fittings, connections, and seams with duct sealant specifically manufactured for that purpose. Refer to and comply with notes on drawings concerning duct sealant, which shall take precedent.
- D. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.
- E. Make all rectangular duct branch connections with 45° entry clinch collar. All elbows 30° and greater shall have turning vanes.
- F. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-15 section "Ductwork Accessories" for accessory requirements.

- G. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.
- H. Rectangular duct sizes called out on plans are clear inside dimensions. Increase duct size as required to accommodate duct liner.

2.4 FACTORY-FABRICATED HIGH PRESSURE AND LOW PRESSURE DUCTWORK

- A. General: Provide factory-fabricated duct and fittings, manufactured on automatic spiral duct forming machines, for round (spiral) low, medium and high velocity duct systems.
- B. Round and Oval Ductwork: Construct of galvanized sheet steel complying with ASTM A527 by the following methods and in minimum gages listed.

<u>Diameter</u>	<u>Minimum Gage</u>	<u>Method Of Manufacture</u>
3" to 14"	26	Spiral Lockseam
15" to 26"	24	Spiral Lockseam
27" to 36"	22	Spiral Lockseam
37" to 50"	20	Spiral Lockseam

Provide locked seams for spiral duct; fusion-welded butt seam for longitudinal seam duct.

- C. Fittings and Couplings: Construct of minimum gages listed. Provide continuous welds along seams.

<u>Diameter</u>	<u>Minimum Gage</u>
3" to 36"	20
38" to 50"	18

Use duct taps for conical 90° tees or takeoffs as per plans. Five piece 90° or smooth ells with 1 1/2 diameter radius, conical 90° reducing tees, conical 90° cross and bell mouth plenum taps.

- D. Internally Insulated Duct and Fittings: Construct with outer pressure shell, 2" thick insulation layer, with thermal conductivity (K-factor) of .27 BTU/Hr/Ft/°F and perforated or solid inner liner as specified on the drawings. Construct shell and liner of galvanized sheet steel complying with ASTM A 527, of spiral lockseam construction, use longitudinal seam for over 59", in minimum gages listed.

<u>Nominal Duct Diameter</u>	<u>Outer Shell</u>	<u>Inner Liner</u>
3" to 12"	26 ga.	24 ga.
13" to 24"	24 ga.	24 ga.
25" to 34"	22 ga.	24 ga.
35" to 48"	20 ga.	24 ga.

- E. Fittings and Couplings: Construct of minimum gages listed. Provide continuous weld along seams of outer shell.

<u>Nominal Duct Diameter</u>	<u>Outer Shell</u>	<u>Inner Liner</u>
3" to 34"	20 ga.	20 ga.
36" to 48"	18 ga.	20 ga.

- F. Inner Liner: Perforate with 3/32" holes for 22% open area or solid liner as specified on the drawings. Provide metal spacers welded in position to maintain spacing and concentricity.

All supply ductwork with perforated inner liner serving Hospital Sensitive Areas shall have 100% mechanical separation of insulation and air stream, to provide positive protection against any possibility of fiber entrainment. United Type PM or equal.

- G. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork of one of the following:

Semco Mfg., Inc.
 United Sheet Metal Div., United McGill Corp.
 Wichita Sheet Metal
 Western Eng.

2.5 FLEXIBLE DUCTS

- A. Flexible ducts - Thermaflex Type MKE for low pressure, low velocity, or equivalent by Wiremold meeting amended code standards of NFPA Pamphlet 90A with U.L. Fire rating of not over 25 flame spread and a developed smoke rating of not over 50. U.L. Standard 181 Class 1 air duct. Duct shall be factory made and composed of: a CPE liner duct permanently bonded to a coated spring steel wire helix and supporting a fiber glass insulating blanket. Low permeability outer vapor barrier of fiber glass reinforced film laminate shall complete the composite. Insulation 1" thick 3/4 lb. density glass blanket with vapor barrier. A maximum of six feet of flexible duct with one 90° elbow or 10 feet of straight run will be used for each connection. Pressure rating of 6" W.G. positive and 2" W.G. negative.

Accessories: Strap clamps Spin-in duct tap connections with Belmouth connector and butterfly dampers.

Installation: Duct connections to collars shall be made in accordance with the duct manufacturer's recommendations. Install flexible duct only where specifically shown on the drawings.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF METAL DUCTWORK:

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (2% leakage) and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor. Field verify exact amount of space available for ducts prior to fabrication. REFER TO NOTES ON DRAWINGS FOR ADDITIONAL INFORMATION.
- B. Inserts: Install concrete inserts for supports of ductwork in coordination with formwork, as required to avoid delays in work.

- C. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- D. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- E. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.
- F. Penetrations: Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten duct and substrate.
 - 1. Where ducts pass through fire-rated floors, walls, or partitions, provide firestopping between duct and substrate, in accordance with requirements of Division-7 Section "Firestopping".
- G. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
- H. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.
- I. Hanger Spacing:
 - 1. Maximum hanger spacing for round duct shall be 10'-0"
 - 2. Maximum hanger spacing for rectangular duct shall be 5'-0".
- J. Ductwork downstream of humidifier shall have all seams and joints welded for a distance equal to the absorption distance plus 3 feet. Absorption distance is that noted on the humidifier schedule.

3.3 INSTALLATION OF DUCT LINER:

- A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.
- B. Note that duct sizes called out on drawings is clear inside dimensions of ductwork. Increase outside dimensions of ductwork to accommodate duct liner.

3.4 INSTALLATION OF FLEXIBLE DUCTS:

- A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6' - 0" extended length.
- B. Installation: Install in accordance with Section III of SMACNA's "HVAC Duct Construction Standards, Metal and Flexible".
- C. Flexible duct shall be used only where specifically shown on drawings.
- D. Install by peeling back the insulation, and install tie strap around flex duct liner and the sheet metal collar.
- E. Restore insulation to original position and duct tape over the end of the insulation to provide vaporproof seal.

3.5 EQUIPMENT CONNECTIONS:

- A. General: Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.6 ADJUSTING AND CLEANING:

- A. Clean Ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of dust, dirt and foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, which might interfere with painting or cause paint deterioration.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

- C. Balancing: Refer to Division-15 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

3.7 DUCTWORK PRESSURE TEST

- A. Duct pressure tests shall be performed using a duct pressurization fan. Test shall be done in accordance with SMACNA HVAC Air Duct Leakage Test Manual by an Independent Balance Agency.
- B. The four tests will be conducted on the following:
 - 1. Low Pressure Supply Air Duct
 - 2. Return Air Duct
 - 3. Exhaust Air Duct.
 - 4. High pressure supply air duct.
- C. The specific ducts to be tested will be selected at random by the Engineer.
- D. If the duct does not meet the SMACNA leakage requirements, it shall be repaired and sealed and retested at the Contractor's expense. Furthermore all other like duct systems shall also be leak tested and sealed if required, all at the Contractor's own expense.
- E. Coordinate pressure test preparation requirements with Test and Balance Agency. Rework of ductwork to accommodate specified testing shall be at the contractor's own expense.

END OF SECTION 15891

SECTION 15910 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.
- B. Types of ductwork accessories work required for project include the following:

- Dampers.

- Low pressure manual dampers.
 - Control dampers.
 - Counterbalanced relief dampers.

- Fire and smoke dampers.
 - Turning vanes.
 - Duct hardware.
 - Duct access doors.
 - Flexible connections.
 - Sound attenuators

- C. Refer to other Division 15 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of duct accessories, or types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible", 1985 Edition.
2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components and installation instructions.
- C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in Maintenance Manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 DAMPERS:

- A. Where specifically called out on the drawings, provide dampers equal to the model numbers specified on the drawing. All other dampers shown on the drawings or required for balancing shall be as specified below.

- B. Low Pressure Manual Dampers: Provide dampers with opposed blades for 2- position control, or opposed blades for modulating control. Construct blades of 16 ga. steel, provide heavy-duty molded self-lubricating nylon bearings, 1/2" diameter steel axles spaced on 9" centers. Construct frame of 4" x 1-1/4" x 16 ga. channel. Provide galvanized steel finish with aluminum touch-up. No single blade rectangular dampers shall be used without specific approval of engineer. Dampers in outside air ducts shall be ultra low leak type with blade and jamb seals, having a maximum leakage of 10 CFM/Ft² of damper area at one-inch W.G. pressure differential.
- C. Control Dampers: Refer to Division-15 section "Control Systems" for control dampers; not work of this section.
- D. Counterbalanced Relief Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to relieve at indicated static pressure. Construct blades of 16 ga. aluminum, provide 1/2" diameter ball bearings, 1/2" diameter steel axles spaces on 9" centers. Construct frame of 4" x 1-1/4" x 16 ga channel. Provide galvanized steel finish on frame with aluminum touch-up.
- E. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:
 - Air Balance Inc.
 - Airguide Corp.
 - American Warming & Ventilating, Inc.
 - Greenheck
 - Louvers & Dampers, Inc.
 - Penn Ventilator Co.
 - Ruskin Mfg. Co.

2.2 FIRE DAMPERS:

- A. Fabricated Fire Dampers: Provide dampers constructed and labeled in accordance with U.L. Standard 555 "Standard for Fire Dampers", dynamic rating. Fire dampers shall bear the U.L. Label Class "B" and shall conform to National Fire Code #90A.
- B. Provide fire dampers, of types and sizes indicated Rated 1.5 hours. Provide fusible link rated at 165 deg F (74 deg C) unless otherwise indicated. Provide damper with positive lock in closed position, and with the following additional features:

1. Damper Blade Assembly: Multi-blade type.
 2. Blade Material: Steel, match casing.
- C. Frame: Type A or Type B as indicated. Fabricated with roll formed, 20 gage, galvanized steel, with mitered and interlocking corners. Integral 20 gage steel frame.
- D. Features: Wall and Floor dampers shall be equal to Ruskin DIBD20 Series and constructed with one piece frame and factory sleeve combination and interlocking blades which will form a solid curtain of steel when closed. When open, the blades are compactly grouped. Dampers suitable for vertical or horizontal installation.
- E. Ceiling fire dampers shall be equal to Ruskin CFD 5 Series, U.L. classified radiation dampers specifically tested and classified to provide fire and heat protection where HVAC components penetrate the ceiling membrane. Provide each unit with thermal radiation blankets to meet U.L. classification for 1 hour roof/ceiling assembly, Kaowool 1/4" thick 8 lb/Ft³ ceramic fiber. Damper sizes shall be compatible with diffuser and grille neck sizes and volume dampers.
- F. Installation of fire dampers must comply with NFPA 90A, U.L. Safety Standard 555, and fire damper manufacturer's instructions. Secure factory sleeve with 14 Ga. 1 1/2 x 1 1/2" perimeter angles and install exterior insulation over sleeve.
- G. Install insulated access door in duct where required for access to fire damper - one 12" x 6" door required in ducts up to 12" wide one 12" x 12" doors required in ducts 13" wide to 30" wide two 12" x 12" doors required in ducts 31" wide to 48" wide three 12" x 12" doors required in ducts 49" wide to 72" wide - Four 12" x 12" doors required in ducts over 72" wide. Multiple doors shall be equally spaced. Each access door for fire and/or smoke damper shall be labeled with letters at least 1/2" high reading "Fire Damper".
- H. All fire dampers in round ductwork shall have 100% free area.
- I. In addition to the fire dampers, shown and called out on the drawings provide additional 1 1/2 hour rated wall type Class "B" fire dampers as specified below to be installed where designated by the Engineer:

- (3) Each 12" wide x 12" High
- (3) Each 18" wide x 12" High

- J. Manufacturer: Subject to compliance with requirements, provide fire and smoke dampers of one of the following:

Air Balance, Inc.
American Warming & Ventilating, Inc.
Louvers and Dampers, Inc.
Penn Ventilator Co.
Ruskin Mfg. Co.
Greenheck

2.3 FIRE/SMOKE DAMPERS:

- A. Fabricated Fire/Smoke Dampers: Provide dampers constructed and labeled in accordance with U.L. Standard 555S "Standard For Leakage Rated Dampers For Use In Smoke Control Systems." Dampers shall bear the U.L. Label for 1.5 hour rated fire damper and shall conform to National Fire Code #90A.
- B. Provide smoke dampers, of types and sizes indicated. Provide fusible link rated at 165 deg F (74 deg C) unless otherwise indicated. Provide control shaft for operation by electric or pneumatic motor.
- C. Rectangular smoke damper shall be equal to Ruskin FSD 36 with Class 2 leakage for low velocity applications and FSD 60, airfoil blade damper, Class I for medium and high velocity applications and may be either parallel or opposed blade damper with galvanized frame and blades - with silicone rubber gasket at blade edges - Oilite or SS bearings. Actuators shall be electric normally open and rated for 350°F. multi product type motor actuators are not acceptable.
- D. Fire/Smoke Dampers are to close on signal from "Products of Combustion Detector" or from power failure.
- E. Fire/Smoke Dampers are to open automatically on signal from "products of Combustion Detector" or power on.
- F. Fire/Smoke Dampers shall also operate as a 1 1/2 hour fire damper and shall have a 165 °F. fusible link.
- G. Provide insulated access door in duct similar to fire dampers for access to smoke damper.
- H. All Fire/Smoke Dampers size 12" x 12" and smaller shall be Style C, CO, or CR as applicable. Dampers larger than 12" x 12" may be Style A.
- I. Cable operated Fire/Smoke Dampers are not acceptable.

- J. Manufacturer: Subject to compliance with requirements, provide fire and smoke dampers of one of the following:

Air Balance, Inc.
Ruskin Mfg. Co.
Greenheck
Nailor

2.4 TURNING VANES:

- A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".
- B. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:

Aero Dyne Co.
Airsan Corp.
Duro Dyne Corp.
Environmental Elements Corp.; Subs. Koppers Co., Inc.

2.5 DUCT HARDWARE:

- A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
 2. Quadrant Locks: Provide for each damper, quadrant lock device with wing nut on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.
- B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:

Ventfabrics, Inc.
Young Regulator Co.

2.6 DUCT ACCESS DOORS:

- A. Standard: Provide access doors in conformance with SMACNA.
- B. Location: Provide access doors in casings, plenums, and ducts where shown on the drawings and where specified for ready access to operating parts including fire dampers, smoke dampers, valves, and concealed coils.
- C. Pressure Clarification: Construct and install access doors in accordance with SMACNA Standards to suit the static pressure classifications and the locations where installed.
- D. Access Doors in Ducts: Provide and size doors as follows:
 - 1. Minimum 12-inch by 12-inch clear opening.
 - 2. When field conditions require an access opening smaller than 16-inch by 12-inch, provide a 24-inch long removable section of casing or duct, secured with quick acting locking devices, 6 inches on centers, to permit ready access without dismantling other equipment.
- E. Door Requirements: Provide doors in casings and duct as follows:
 - 1. Arrange doors so that system air pressure will assist closure and prevent opening when the system is in operation.
 - 2. Coordinate doors and equipment to provide unrestricted passage through clear door opening, without removal of any equipment.
 - 3. Where pressure regulating dampers are installed in ducts or plenums, provide access doors with a clear wire glass observation port, 6-inch by 6-inch minimum size. Anchor port with structural metal frame, resilient gaskets and stainless steel bolts.
 - 4. Hinges for doors in zinc coated or aluminum construction shall be steel or iron, zinc coated with brass pins.
 - 5. Hinges for doors in copper, copper nickel alloy construction shall be all brass.
 - 6. Seal around frame attachment to duct and door to frame with neoprene or foam rubber seals.

7. Each access door for fire and/or smoke damper shall be labeled with letters at least 1/2" high reading "Fire Damper".
8. Access Door Materials Schedule

Duct Pressure Class	Door Size Inches	Number Of Hinges *	Number Of Locks	Metal Gage		
				Frame	Door	Back
2 Inches & Less	12 x 12	2	1-S	24	26	26
	16 x 20	2	2-S	22	24	26
	24 x 24	3	2-S	22	22	26
3 Inches	12 x 12	2	1-S	22	22	26
	16 x 20	2	1-S,1-T,1-B	20	20	26
	24 x 24	3	2-S,1-T,1-B	20	20	24
4 To 10 Inches	12 x 12	2	1-S,1-T,1-B	20	20	26
	16 x 20	3	2-S,1-T,1-B	20	18	24
	24 x 24	3	2-S,2-T,2-B	18	18	24

S: Side

T: Top

B: Bottom

*: Optional To Use Continuous Piano Hinge

- F. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:

Air Balance Inc.
Duro Dyne Corp.
Ruskin Mfg. Co.
Ventfabrics, Inc.
Zurn Industries, Inc., Air Systems Div.

2.7 FLEXIBLE CONNECTIONS:

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL Standard 181, Class 1.

- B. Fans Provide flexible connections between fans and ducts or casings where indicated on the drawings or required to accommodate expansion and vibration.
- C. Length: Limit flexible connections to 4-inch active length in the direction of air flow.
- D. Standard: Construct in accordance with SMACNA Standards.
- E. Material: Construct connections of following as applicable:
 - 1. Conventional Indoor System Flexible Connectors Fabric: Glass fabric double coated with polychloreprene.

Minimum Weight: 26 oz per sq. yd.

Tensile Strength: 480 lb per inch in the warp and 360 lb per inch in the filling.
 - 2. Conventional, Outdoor System Flexible Connectors Fabric: Glass fabric double coated with Du Point's HYPALON or other synthetic-rubber weatherproof coating resistant to the sun's ultraviolet rays and ozone environment. Temperature range -10°F to +250°F.

Minimum Weight 26 oz. per sq yd.

Tensile Strength: 530 lb per inch in the warp and 440 lb per inch in the filling.
 - 3. High-Temperature System Flexible Connectors: Glass fabric coated with silicone rubber and having a minimum weight of 16 oz. per sq yd and tensile strength of 285 lb. per inch in the warp, and 185 lb per inch in the filling. Temperature Range -25°F to +500°F.

2.8 SOUND ATTENUATORS

- A. Manufacturers: Rink, Titus, Koppers Co., - Industrial Acoustics Co. -Anemostat, United Sheet Metal.
- B. Capacities: Capacity and size as scheduled on the plans.
- C. The attenuators shall be constructed of 22 gauge or heavier galvanized steel sheets. Lock formed seams shall be mastic filled. Casing shall be airtight up to 10" of water static pressure.

- D. The interior configurations shall be straight through passages of consistently exact dimensions to insure uniform performance.
- E. Circular silencers shall have round duct connections.
- F. The interior panels shall be 22 gauge galvanized steel, die stamped in one piece, and a perforated air passage, corrugated in the direction of the airflow.
- G. All interior components of the sound traps shall be held in place by spot welding.
- H. The acoustical filler shall be inorganic compressed not less than 5% covered by a mylar liner to comply with hospital regulations.
- I. U. L. Composite Fire Ratings:
 - Flame Spread not over 15
 - Fuel Contributed 0
 - Smoke Developed 0.
- J. Copies of Lab. test reports shall be furnished by attenuator manufacturer to verify compliance with specifications.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES:

- A. Install duct accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install turning vanes in square or rectangular 30 deg elbows or greater, in supply and exhaust air systems, and elsewhere as indicated.

- C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
- D. Installation of fire dampers must comply with NFPA 90A U.L. Safety Standard 555, and fire damper manufacturer's instructions. Secure sleeve with 14 Ga. 1 1/2 x 1 1/2" perimeter angles and install exterior insulation over sleeve.
- E. In addition to installing fire dampers as shown and called out on the drawings, the Contractor shall include in his bid the installation of the following additional fire dampers at locations designated by the Engineer:
 - (3) Each 12" Wide x 12" High.
 - (3) Each 18" Wide x 12" High.
- F. Install insulated access door in duct where required for access to fire damper - one 12" x 6" door required in ducts up to 12" wide one 12" x 12" doors required in ducts 13" wide to 30" wide two 12" x 12" doors required in ducts 31" wide to 48" wide three 12" x 12" doors required in ducts 49" wide to 72" wide - Four 12" x 12" doors required in ducts over 72" wide.
- G. Coordinate with other work, including ductwork, as necessary to interface installation of duct accessories properly with other work.
- H. Provide air tight seal where flexible connection attaches to duct work.
- I. Install sound attenuators with rigid angle iron supports anchored to structure.

3.3 FIELD QUALITY CONTROL:

- A. Operate installed duct accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.
- B. All fire dampers shall be tested for proper closure by the Contractor witnessed by the Contracting Officer's Representative, and duly recorded and submitted to Engineer for approval. Selected fire dampers may be additionally tested during final inspection.

3.4 ADJUSTING AND CLEANING:

- A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
 - 1. Label access doors in accordance with Division-15 section "Mechanical Identification".
 - 2. Final positioning of manual dampers is specified in Division-15 section "Testing, Adjusting, and Balancing".
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 EXTRA STOCK:

- 1. Furnish extra fusible links to Contracting Officer's Representative, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 15910

SECTION 15932 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of outlets and inlets required for project include the following:
 - Ceiling air diffusers.
 - Wall and floor registers and grilles.
- C. Refer to other Division-15 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.
- D. Refer to other Division-15 sections for balancing of air outlets and inlets; not work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturers Qualifications: Firms regularly engaged in manufacture of outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
 - 2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
4. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters."
5. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's data on outlets and inlets including the following:
 1. Schedule of air outlets and inlets indicating drawing designation, type, room location, number furnished, model number, size, and accessories furnished.
 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CEILING AIR DIFFUSERS:

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule. Use all steel diffusers where fire dampers are required.
- E. Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:

Krueger Mfg. Co.
Titus Products Div.; Philips Industries, Inc.
Air Guide
Price

2.2 WALL AND FLOOR REGISTER AND GRILLES:

- A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide wall or floor registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Wall or Floor Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall or floor systems, and that are specifically manufactured to fit into wall or floor construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.

- D. Types: Provide wall or floor registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule. Provide all steel registers where fire dampers are required.
- E. Manufacturer: Subject to compliance with requirements, provide registers and grilles of one of the following:

Titus Products Div.; Phillips Industries, Inc.
Krueger
Air Guide
Price

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate ceiling air diffusers, registers, and grilles, as indicated on plans. Unless otherwise indicated locate units in center of acoustical ceiling modules. Locate units so that ceiling grid is not cut.
- D. Install balancing damper with locking quadrant in runout to linear slot diffusers.

END OF SECTION 15932

SECTION 15973 - TEMPERATURE CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of temperature control systems work required by this section is indicated by drawings and schedules, and by requirements of this section.

Control sequences are specified herein.

- B. Refer to other Division-15 sections for installation of instrument wells, valve bodies, and dampers in mechanical systems; not work of this section.

- C. Refer to Division-16 sections for the following work; not work of this section.

- 1. Power supply wiring from power source to power connection on controls and/or unit control panels. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
- 2. Interlock wiring between electrically-operated equipment units; and between equipment and field-installed control devices.

Interlock wiring specified as factory-installed is work of this section.

- D. Provide the following electrical work as work of this section, complying with requirements of Division-16 sections:
 - 1. Low voltage control/FMS system wiring between field-installed controls, indicating devices, and unit control panels.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's: Temperature controls shall be manufactured and installed by Control Systems International.
- B. Installer's Qualifications: Firms specializing and experienced in control system installations for not less than 5 years.
- C. Codes and Standards:
 - 1. Electrical Standards: Provide electrical components of control systems which have been UL-listed and labeled, and comply with NEMA standards.
 - 2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.
 - 3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's specifications for each control device furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes, also include installation and start-up instructions.
- B. Shop Drawings: Submit shop drawings for each DDC/electric control system, containing the following information:
 - 1. Schematic flow diagram of system showing chillers, fans, pumps, coils, dampers, valves, and control devices.
 - 2. Label each control device with setting or adjustable range of control.
 - 3. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed. Include a ladder diagram.
 - 4. Provide details of faces of control panels, including controls, instruments, and labeling.

5. Include verbal description of sequence of operation.
- C. Maintenance Data: Submit maintenance instructions and spare parts lists for each type of control device. Include that type data, product data and shop drawings in maintenance manual; in accordance with requirements of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Provide factory shipping cartons for each piece of equipment and control device. Maintain cartons while shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

- A. General: Provide control products in sizes and capacities indicated consisting of valves, dampers, thermostats, clocks, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.
- B. Control Valves: Provide factory fabricated pneumatic control valves of type, body material and pressure class indicated.

Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Equip control valves with heavy-duty actuators, with proper shutoff rating for each individual application.

1. Water Control Valves: Equal percentage characteristics with rangeability of 50 to 1, and maximum full flow pressure drop of 4 PSIG.
2. Single Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.
3. Double Seated Valves: Balanced plug type, with cage type trim providing seating and guiding surfaces on "top and bottom" guided plugs.
4. Valve Trim and Stems: Polished stainless steel.

5. Packing: Spring-loaded Teflon, self-adjusting.
- E. Dampers: Provide automatic control dampers as indicated. Provide mounting holes for enclosed duct mounting. See damper schedule for construction and leakage requirements.
1. Secure blades to 1/2" diameter zinc-plated axles using zinc-plated hardware. Seal off against spring stainless steel blade bearings. Provide blade bearings of nylon and provide thrust bearings at each end of each blade. Construct blade linkage hardware of zinc-plated steel and brass. Submit leakage and flow characteristics plus size schedule for controlled dampers.
 2. Operating Temperature Range: From -20 to 200 deg F (-29 to 93 deg C).
 3. For standard applications as indicated, provide parallel or opposed blade design (as selected by the manufacturer's sizing techniques) with closed-cell neoprene edging.
 4. For low leakage applications as indicated, provide parallel or opposed blade design (as selected by manufacturer's sizing techniques) with inflatable steel blade edging, or replaceable rubber seals, rated for leakage less than 8 CFM/sq. ft. of damper area, at differential pressure of 4" w.g. when damper is being held by torque of 50 inch-pounds.

2.2 FACILITY MANAGEMENT SYSTEM

A. DESCRIPTION

1. It is the intent of this specification to describe the basic architecture and performance requirements of the Facility Management System (FMS). The FMS shall be based on a distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on a true peer-to-peer, token passing Local Area Network (LAN), called the Controller LAN. All "primary" equipment shall be served by stand alone controllers residing directly on this Controller LAN. System architectures with primary equipment controllers residing on master/slave (polling) networks or sub-networks will not be acceptable. The Facility Management System shall include all work station software and hardware, Distributed Control Units (DCUs), Local Area Networks (LANs), sensors, control devices, actuators, installation and calibration, supervision, adjustments and fine tuning necessary for a complete and fully operational system.

2. Each installation shall comply with local, state, and federal code requirements as applicable. Acceptable manufacturers for the FMS is Control Systems International, providing their systems comply with this specification. This manufacturer is required in order to provide full and complete compatibility with the existing Century-II system.
3. Provide a two year warranty on hardware, software, and firmware for all items provided by the control system manufacturer.

B. CENTRAL WORK STATION HARDWARE

1. The system specifically must have the capability to support not less than fifteen (15) work stations connected on the network at the same time. The FMS shall allow all connected work stations to function in a true multi-user, multi-tasking environment such that:
 - All terminals can access the same network at the same time.
 - All terminals can access and/or control the same DCU at the same time
 - All terminals can access and/or modify the same DCU database at the same time
 - All terminals shall be able to archive data, alarms, and network actions to hard disk regardless of what application programs are being currently executed (i.e., LAN operating system, spreadsheets, word processing, etc.). All archiving disk traffic shall be accomplished on line without effecting the operation of the current programs.
2. Additional on-line functions required to be supported concurrently in every work station, without rebooting, shall include but not be limited to: on-line data base development and editing, on-line DDC implementation and tuning, on-line graphics development, and real time facility control. The Contractor shall provide work stations as shown on the plans. Each work station shall include as a minimum the following components:
 - a. Computer: The computer work station shall be supplied with a minimum configuration of 8 Mb RAM, dual RS232 Serial ports, 14" VGA color monitor, a 1.44 Mb floppy disk drive, a CD-ROM, a 500 Mb hard disk drive, and a Microsoft Mouse. The computer shall be supplied with the proper disk operating system to comply with project requirements. Processor shall be a 486DX2/66 or better.

- b. Operating System: The Operating System shall be Microsoft DOS or Microsoft Windows. OS/2 and UNIX operating systems are not acceptable.
- c. Printer(s): Provide an 80-column hard copy printer which will support full graphic features and is rated at no less than 100 cps. The printers shall use standard form fold paper with tractor feed and shall be provided with two (2) boxes of paper. The printer shall be an Epson Model FX-850 or equivalent. Where two (2) printers are shown on the plans for a work station, the second must be a color printer.
- d. Modem: For PC work stations connected to the Controller LAN remotely via telephone lines, provide an autodial/autoanswer modem with all cables and all communication interfaces required to provide the specified functions.

C. LOCAL AREA NETWORKS (LAN):

- 1. Controller LAN: The FMS shall provide communication between the DCU's over a Local Area Network (LAN).
 - a. The Controller LAN shall be a high speed "bus type" network over which information is transmitted in a "global" fashion between all the nodes on the network.
 - b. The Controller LAN shall have the capacity to contain not less than 64 nodes as a minimum. Each work station, DCU, or "gateway" device shall represent a node to the network.
 - c. The Controller LAN shall connect the nodes in a fully distributed environment, each DCU operating autonomously while communicating with all other nodes on the network. Controller LANs requiring a communication controller (for any reason) will not be acceptable. LAN lengths in excess of 24,000 ft. shall be supported.
 - d. A break in the communication path of the Controller LAN shall be announced as an alarm and shall automatically initiate a Controller LAN reconfiguration such that the resulting sections of the Controller LAN continue to function as separate LANs. No loss of control shall result from such a break in the Controller LAN.

2. Commercial LAN: Work stations on the Controller LAN may also reside on a higher tier "commercial" LAN. This "commercial" LAN shall be based on Ethernet, and comply with IEEE 802.3 standards. Where a "commercial" LAN is implemented, it shall be possible to connect multiple Controller LANs together, with global data sharing across this commercial LAN.
 - a. Data speed shall not be less than 10 Megabaud.
 - b. The "commercial" LAN shall support up to 63 work stations, including as many as 8 dedicated backup work stations serving to continuously backup the database on the other work stations. A single work station shall be able to be backed up by more than one backup work station.
 - c. An operator at a work station on the "commercial" LAN may connect to any other work station on the "commercial" LAN as if the operator were sitting at the other work station.
 - d. Alarms and special event notices shall be routed to different work stations on the "commercial" LAN based on time of day, and day of the week.
 - e. Operator password assignment shall be available on both a system-wide basis and a workstation by workstation basis.

D. TRANSMISSION SYSTEM

1. The FMS shall utilize the above LAN architecture to allow all of the Distributed Control Units to share data as well as to globalize alarms. The Controller LAN shall be based on a peer-to-peer, token passing technique with a data speed of not less than 19.2 Kb. Systems which require a "master" communications controller or network manager for the Controller LAN are not acceptable.
2. Communication Techniques: The Controller LAN shall support node interface devices for the work stations which shall function as a "gateway" to convert, buffer, and filter the Controller LAN data to the RS-232 data port of the PC work station. These "gateway" devices shall support local hardwired work stations as well as auto-answer/auto-dial modems and remote pagers. The "gateways" shall allow PC work stations to interface to the Controller LAN at

any point on the network directly or via telephone lines without having to be connected to a DCU in order to communicate with the system. Communication over telephone lines must be supported utilizing either external Bell 103 type modems or proprietary data modems. Where external commercial modems are used, a Hayes Smartmodem shall be provided as specified. Telephone lines will be provided by the owner. The system supplier shall include a Controller LAN resident auto-dial/auto-answer modem and "gateway" to allow remote communication with the system.

- a. To ensure high throughput, data transmission shall use "packetized" communication techniques, such that dozens of "messages" are contained in each "packet".
 - b. When one PC work station is connected to a remote site via a telephone line, additional PC work stations at the same "service center" location shall be able to share the same telephone line.
 - c. Allow remote sites to autodial PC workstations based on regularly scheduled intervals or after a predetermined number of messages have been stored (operator selectable).
3. Network Support: The "turnaround time" for a global point to be received by any node, including operator stations, shall be less than 3 seconds. The Controller LAN shall provide for automatic reconfiguration if any station (Distributed Control Unit, PC work station, gateway, etc.) is added or lost. Should the transmission cable be cut, the two sections shall reconfigure with no disruption to the system's operation and without any operator intervention.
 4. Network Trees & Summaries: Provide automatic, on-line configuration summaries listing each device or node on each tier of a multi-tiered FMS system architecture. Separate summaries shall exist for: Controller LAN, Commercial LAN (if used), and MicroController (MC) network (if used). Each summary shall list the point address/name, the device type, the device name, the revision level, and the revision date.

E. FIELD HARDWARE:

1. Distributed Control Units (DCU): All points in the system shall be monitored and/or controlled through "intelligent" Distributed Control Units (DCU's). Each DCU in the system shall contain its own microprocessor and memory with a minimum 300 hours battery backup. Each DCU in the system shall be a completely independent stand-alone "master" with its own hardware clock calendar and all firmware and software to maintain complete control on an independent basis. Each DCU shall include the following capabilities:

- a. Acquire, process, and transfer information to the PC operator work stations or other DCU's on the network.
 - b. Accept, process, and execute commands from the other DCU's or other input devices, or multiple PC work stations.
 - c. Allow access to both data base and control functions by multiple work stations at the same time.
 - d. Record, evaluate, and report the changes of state and/or value that occur among points associated with the DCU. If any operator work station or transmission network fails, but the power to the DCU does not, the DCU shall continue to perform all control functions associated with the points to which the DCU remains connected.
 - e. Specifically, a DCU shall contain memory and processing capability to perform in a stand-alone mode:
 - Scheduled start/stop
 - Adaptive optimized start/stop
 - Duty cycling
 - Automatic temperature Control
 - Demand control via a sliding window, predictive algorithm
 - Event initiated control
 - Calculated point
 - Scanning and alarm processing
 - Full Direct Digital Control
 - Trend logging
 - Global communications
 - Maintenance scheduling
2. DCU Global Communications: Each DCU shall have the ability to transmit any or all I/O points as global points onto the network for use by other DCU's and to utilize data from other panels as part of its data base. To maximize system throughput, and minimize unnecessary network traffic, analog inputs shall be transmitted only after an operator specified change of value has occurred since the last broadcast value. This change of value threshold shall be operator selectable on a per point basis.
 3. DCU Field Input/Output Capability: The following point types must be supported by the DCU's.

- Discrete/digital input (contact status).
 - Discrete/digital output (maintained, momentary, dual momentary, floating).
 - Analog input (0-20 mA, or 0-5 VDC or 0-10VDC with 12-bit A/D conversion resolution minimum).
 - Analog output (0-10 VDC with 8-bit D/A resolution minimum).
 - Pulse input capable of accepting 10 pulses/second and accumulating total.
 - Pulse Width Modulation (PWM) output capable of producing a pulse anywhere between 0-655 seconds in duration with 0.01 second resolution.
- a. Every discrete/digital output and PWM output shall have an HOA switch with individual feedback as to the position of the switch, unless the DCU has an integral keypad/display device.
4. Each DCU shall have the ability to monitor, control or address not less than 300 data points.
5. DCU Point Scanning: It shall be possible to independently set the scan or execution speed for each point in the DCU to an operator selected time from 1 to 254 seconds.
6. DCU Upload/Download Capability: Each DCU shall be able to download from or upload to any PC operators work station. All point data shall be modifiable from any authorized PC operators work station and downloaded to the DCU over the Controller LAN. It shall not be necessary to enter parameters locally at the DCU for control programs to take effect. This upload/download shall be readily performed on a regular basis without interrupting the control functions in the DCU. All upload/downloads shall be performed without the operator workstation being taken "off-line", and shall be completed in no more than 15 seconds.
7. DCU Diagnostics: provide diagnostics which support the following dynamic (one second refresh) parameters:
- Processor loading
 - LAN Loading
 - Memory data

8. DCU Test Mode Operation: Each DCU shall have the ability to place input/output points in a test mode. The test mode shall allow control algorithms to be tested and developed on line without disrupting the field hardware and controlled environment. The treatment of all I/O points in the test mode shall be as follows:
- a. Scanning and calculation of all input points in test mode shall be inhibited. Manual control of input points in test mode will allow setting the analog or digital input point to an operator determined test value, which can be issued from any fixed or portable operator console.
 - b. It shall be possible to control all output points, but only the data base state/value shall be changed - the external field hardware is left unchanged. Failure to provide test mode capability will preclude acceptance.
- 9 DCU Local Operator Console: Furnish at each DCU location provisions for connection of a local operator's console. If the console is not of the portable type, a permanent door mount type with display shall be provided at each DCU. The console shall be capable of full global communications with all DCU's on the Controller LAN when connected to any DCU on the Controller LAN. Systems not offering this global communication capability shall be unacceptable under this specification. It shall be possible to perform as a minimum the following functions through the local operator console:
- Set/display date.
 - Set/display time.
 - Display the status or value of all points connected to the DCU or any other DCU on the Controller LAN.
 - Control the outputs connected to the DCU or any other DCU on the Controller LAN.
 - Enable/disable any or all automatic control outputs.
 - Perform DCU diagnostic testing.
 - Place any or all points in "Test" mode.
 - Display DCU CPU "percentage processing time" so that system and DCU processor loading may be determined. Also, display the amount of DCU programming memory available and the amount currently used.
- a. Where a portable, laptop, or notebook PC is provided as the local operator console, the operator interface shall be identical to the primary PC work station, and require no additional training to operate.

10. MicroController Interface: Application Specific Controllers (ASCs) shall be connected to the Controller LAN via a Micro Controller Interface (MCI). The MCI shall be a DCU without any directly connected points. ASCs shall be connected to the MCI via a high speed, RS-485 sub-network. For system reliability, distribution of risk, and high throughput, not more than 64 ASCs shall be connected to any single MCI, and this MCI shall not share processors or Controller LAN interfaces with a DCU that is hardwired to primary equipment.
 - a. The MCI shall provide common, and memory intensive functions for locally connected ASCs, including: time scheduling, custom or global calculations, and historical data collection. The operator interface for all MCI database entry and application programs shall be fully integrated and consistent with other DCUs.
 - b. The MCI shall support sub-networks consisting of counter-scanning loops for increased system availability. Upon a single break (i.e., severed wire) the MCI shall scan the loop in both the primary and secondary directions and maintain communications with all ASCs - not just those located between the MCI and the fault.

11. Application Specific Controllers: Application Specific Controllers (ASCs) shall be utilized for zone or terminal equipment only. Applications include:
 - Fancoils, small packaged AHUs,
 - a. Application Specific Controllers shall function standalone for the local loop functions of the terminal unit. Complete PID algorithms or fuzzy logic shall reside and execute at the ASC level.
 - b. Micro Controller Field Input/Output Capability: The following point types must be supported by the ASCs:
 - Discrete/digital input (contact status).
 - Discrete/digital output (maintained, floating).
 - Analog input (temperature sensors with 8-bit A/D conversion resolution minimum).
 - Pulse Width Modulation (PWM) output capable of producing a pulse anywhere between 0-655 seconds in duration with 0.01 second resolution.

- c. No Potentiometers, batteries, filters, or other maintenance items shall be present on the ASC. The database entry and personality assignment of the ASC shall be fully integrated and consistent with all other points in the system, whether resident in a DCU or an ASC. All programs shall be contained on the ASC in firmware, and all database shall be contained on the ASC in nonvolatile NOVRAM. All input and output points in the ASC shall be available for display, command, and on-line editing at the primary PC work stations. Points unused by the local terminal unit application, may function as a system point.
- d. Triple setpoints shall reside in each ASC for both heating and cooling: Occupied, Unoccupied, and Economy. Occupied and Unoccupied shall follow the time schedule, or other event initiator in the MCI. Economy setpoints shall be activated to widen the Occupied deadband during periods of high electrical demand, in lieu of duty cycling or load shedding the terminal equipment.
- e. To ensure "tight" integration between all system hardware and software, as well as long term component availability, the MCI, ASC, and ASC sensors shall be originally manufactured by the same manufacturer who supplies the DCUs, Controller LAN, and workstation application software. Private labeling of these components does not fulfill this requirement.

2.3 FMS SOFTWARE

A. General:

1. This Contractor shall provide all software required for efficient operation of all the automatic system functions required by this specification. Software shall be modular in design for flexibility in expansion or revision of the system. It is the intent of this specification to require provisions of a system which can be fully utilized by individuals with no, or limited, previous exposure to PC's and programming techniques and languages. If the system to be provided requires the use of any modified BASIC, "C", PASCAL, or DRUM Language program, or writing "line" programming statements to modify operation or strategy in the system, the vendor shall provide unlimited, no charge, software modification and support for a period of five (5) years after the completion of the project in addition to the warranty period specified elsewhere. Systems which are factory programmed are unacceptable.

2. The software shall include a General Purpose Operating system, as well as Facility Management System Application software. All available vendor work station application software shall be provided with the system, and shall reside in each and every PC. "Unbundled" software packages where the vendor can charge the user extra fees, or require dedicated work stations, or require system rebooting for access, are unacceptable.
3. The software in the system shall consist of both "firmware" resident in the DCU's and "software" resident in the operator work stations. The architecture of the system, and the application software/firmware shall be distributed with no single system component responsible for a control function for the entire Controller LAN. Each DCU shall contain the necessary firmware and I/O capability to function independently in case of a network failure. No active energy management or environmental control sequences shall be resident in the PC work stations. All PC work stations shall be removable from the system without loss of control function - only alarm monitoring, long term history collection, and operator monitor/command/edit functions would be lost.

B. BUILDING MANAGEMENT SYSTEM SOFTWARE:

1. The primary operator interface to the system shall be through a graphical, "object oriented", interactive presentation using a mouse and cursor for object selection and commands.
 - a. The system shall support an operator definable "default" system page. The default system page shall be displayed upon system startup, operator activity time-outs, and when the system is not in use. This default system page may be any one of the standard dynamic graphic pages, or may be a custom display developed for this purpose. The operator shall be able to display their corporate logo, emergency information, an index of all graphic pages, etc. as the default system page.
 - b. The cursor shall be a "floating arrow".
 - c. The system shall support "pop-up" windows for point commands. On selecting an object with the cursor, a window shall open up to present the operator with choices corresponding to the operator's password authorizations. These point commands shall include state changes, manual override of application software, test mode activation and test value entry. This window shall include, for reference, the point's descriptor (name), the point's hardware address, and alarm status.

- d. The system shall support "pop-up" windows for point editing. On selecting an object with the cursor, a window shall open up to present the operator with a list of active point database editors, if permitted by the operators password level. Selecting one of these editors shall allow the operator to modify the basic parameters associated with a point, as well as access any programs assigned to the point (such as time schedules, calculations, events, etc.).
- e. The system shall be based on interactive prompts and choices, using "dialog boxes" as opposed to memorization of commands, "syntax", exact spellings, etc. This interactive prompt and choices approach shall be used in monitoring, issuing commands, and editing. Command choices shall be as simple as "clicking" the cursor over the correct word choice prompts (i.e., ON OFF), without typing in the letters. Editing mode choices shall prompt with ranges or options (i.e., 16 CHARACTERS for point name, or DIRECT/REVERSE for action).
- f. Dynamic Graphics Programming: The operator shall have the ability to construct "dynamic" graphics pages for monitoring and system control. This graphics utility shall be usable both for on-line control such a momentary release and alarm acknowledgment, and for display of system status and alarm activity.

Monitoring and control configuration capability shall include:

- Each point type (AI, DO, etc.)
- Multiple Page Links
- Doors (access control)
- Elevators (access control)

The graphics system will support the use of Windows Bitmap (.BMP) files to be used as backdrops for the placement of alarm and or door control icons.

Text may be inserted onto the graphic to describe the sequence of operation in sentence format. Once completed the graphics shall be able to be printed out for permanent records.

During and/or after completing construction of the graphics screen, the cursor may be placed on the Icon, and by "clicking" the mouse, the associated database editor for adding, deleting, or modifying the point, will be available. Similarly, the point may have its "pop-up" window called up to issue point commands, alarm acknowledgments or overrides. Systems requiring graphic programming languages which are off-line, or require time delays for compiling, or which are not integrated into the

primary operator work station are not acceptable.

g Zoom: It shall be possible for an operator to locate any system point to monitor status, issue commands, or edit associated database without knowledge of the point's name, address, or associated controller, and without having to refer to a "tree" directory. The operator shall be able to zoom in on a building in a campus graphic, zoom in on a floor in a building graphic, zoom in on a door in a floor plan graphic, etc.

2. The system software shall be compiled for faster execution speeds and shall offer all of the following features and capabilities:

a. Input/Output Capabilities: From any local PC work station or any remotely connected PC work station, the system operator shall have the capabilities through the keyboard/mouse to:

Request dynamic displays of current values or status using a tabular or graphic format. A global database sort utility shall allow an expanded tabular display of only the points on the current graphic display. This expanded tabular display shall list point name, hardware address, dynamic state or value, alarm status, override status, and test mode status.

Command selected equipment to a specified state.

Initiate logs and reports

Change analog limits

Add, delete, or change points within each DCU or application routine.

Change point I/O descriptors, status, and alarm descriptors and engineering unit descriptors while the system is on-line.

Add new DCUs and MCs to the system while the system is on-line.

Modify and set up maintenance scheduling parameters.

Develop, modify, delete or display full range of colorgraphic displays providing dynamic, animated displays. All development, editing and display work shall be performed with the system fully on line and in full communications with the Controller LAN.

Select discrete or analog sample data from the field to be automatically archived in the assigned work station.

A comprehensive report writer capability shall be provided in each work station to sort and extract data from the archived files and to generate finished custom reports. Reports shall be capable of manual initiation and/or printout as well as automatic printout. The system will have the capability to print reports on a daily, weekly, monthly, yearly or scheduled basis. The system will have the capability to print reports as a result of an "event". This report writer shall provide the capability for statistical data manipulation and extraction. As a minimum the custom report writer must provide the capability to generate four types of reports: 1) Statistical detail reports, 2) Summary reports, 3) Trend graphic plots for up to four variables, 4) x-y graphic plots.

This report function shall be "on-line" for both development and printout, and shall not require export to a third party spreadsheet program for execution.

In addition to this "on-line" function, the historical database shall be capable of being converted to Data Interchange Format (DIF) for use in third party spreadsheet programs such as Lotus 1-2-3, for off-line manipulation. Transmission to DIF files shall be manual, event driven, or automatic based on operator selectable parameters including: time of day, frequency (daily, weekly, monthly, yearly), scheduled days (32 days minimum). File transfer shall support "appending" new data to the existing file data.

Support two printer operations. The alarm printer will print all alarm annunciation and return to normal, operator acknowledgments, action messages, system alarms, operator sign-on and sign-off. All operator control activities shall include the operators initials in the printed and disk record.

The data printer will be reserved for printing reports, page prints, and data base prints. Both printer functions shall be available from any PC work station.

The operator will have the option of selecting daily, weekly or monthly as a scheduled frequency to synchronize time and date in Distributed Control Units from the PC workstation. This function will be performed for dial up as well as direct connected locations. This program shall accommodate automatic daylight savings time adjustments.

The operator may print a selected Distributed Control Unit data base whenever desired. The operator shall be able to select any or all control parameters as needed. A "bindable" printout of the database of each DCU (including MCs), with a floppy disk backup shall be submitted with "as-builds" as part of the final acceptance procedure.

The CRT shall have a feature to indicate audibly and visually, Off-Normal conditions and messages pending, whether in FMS operating mode or third party software mode.

The operator may request a summary of all points on the Controller LAN currently in the "test" mode or in an off-normal condition.

- b. Operator Access: Operator access to the FMS shall be via software password at every PC work station and at each DCU. Over 1000 passwords/operators shall be supported. The Government will not be constrained to fixed password levels, but may enable any or all the following functions for any operator:

COMMAND FUNCTIONS

- View graphic pages
- Test-on/Test-off
- Point monitor
- Alarm acknowledgment
- Point control
- Manual override
- View summaries
- Exit from FMS to DOS

DATABASE FUNCTIONS

- Passwords
 - Graphic pages
 - Report generator
 - Trend sampling
 - Message routing
 - Off-line database editing
 - DCU database save & restore
 - On-Line database editing
 - Holiday schedules
 - DDC control modules
 - Time schedules
 - Event sequences
 - Calculations
 - Demand control parameters
 - Micro controller parameters
 - Runtime parameters
- c. Data Base Creation and Support: The intent of this specification is to provide an FMS system which will allow the owner to independently perform his own modifications to the system from any operator work station. All changes shall be done utilizing standard procedures and must be capable of being done while the system is on-line and operational.

Add and delete points.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which pneumatic control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF PNEUMATIC CONTROL SYSTEMS:

- A. General: Install system and materials in accordance with manufacturer's instructions, roughing-in drawings and details on drawings. Connect pneumatic air supply system to duplex air compressor and dryer provided by the Temperature Control Contractor.

B Control Wiring: Install control wiring, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code.

1. Install circuits over 25-volt with color-coded No. 12 wire in electric metallic tubing.
2. Install circuits under 25-volt with color-coded No. 18 wire with 0.031" high temperature (105 deg F (41 deg C)) plastic insulation on each conductor and plastic sheath over all.
3. Install electronic circuits with color-coded No. 22 wire with 0.023" polyethylene insulation on each conductor with plastic-jacketed copper shield over all.
4. Install low voltage circuits, located in concrete slabs and masonry walls, or exposed in occupied areas, in electric conduit.

3.3 DESCRIPTION OF OPERATION:

- A. A detailed description of operation for each control system is called out on the plans.
- B. A general description of operation applicable to all systems is required per the following.
 1. All modulating control dampers shall have pilot positioners. Provide pilot positioners elsewhere as shown on drawings.
 2. All modulating control valves 1 1/4" size and above shall have pilot positioners. Provide pilot positioners elsewhere as shown on drawings.
 3. All air handling units and fan coil units shall have a freeze stat to shut-down the unit @ 38°F.
 4. All AHU's shall have a two-position secondary ultra-low leak O.A. damper to close when unit is off. (Damper by T.C.C.)
 5. Air Handling Unit mixing box dampers shall be by the Unit Manufacturer. Controls shall close the O.A. damper when the unit is off.
 6. Unless otherwise noted: Unoccupied heating setpoints shall be 60°F. Unoccupied cooling setpoints shall be 90°F.

7. All dampers located in outside air ducts i.e. intake, relief, exhaust shall be ultra low leak type with both blade and jamb seals. Provided by the T.C.C.

3.4 ADJUSTING AND CLEANING:

- A. Start-Up: Start-up, test, and adjust control systems in the presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damage or malfunctioning controls and equipment.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- C. Final Adjustment: After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this section.
 1. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

3.5 CLOSEOUT PROCEDURES:

- A. Owner's Instructions: Provide services of manufacturer's technical representative for one 8-hour day to instruct Government's personnel in operation and maintenance of pneumatic control systems.
 1. Schedule instruction with Government, provide at least 7-day notice to Contractor and Contracting Officer's Representative of training date.
- B. Owner's Instructions: Provide services of manufacturer's technical representative for one 8-hour day to instruct Government's personnel in operation and maintenance of DDC control systems.

END OF SECTION 15973

SECTION 15990 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1. RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of testing, adjusting, and balancing work required by this section shall include a preliminary balance of Air and Water systems together with preparation of the systems for, and cooperation with, the independent Air and Water Balance Contractor. This work by the Mechanical Contractor shall include the following:
 - 1. Carefully check all piping during installation to make certain that water systems are installed free from foreign material (stones, sand etc.).
 - 2. Clean the water in the piping system, remove strainer covers and clean baskets, and place all associated equipment in operation.
 - 3. Bleed all air from the hydronic system.
 - 4. Provide Pete's Plug gage ports with screw on caps at the inlet and outlet of each piece of equipment attached to the water heating, cooling and piping systems. (Coils, pumps, connectors, airtrol fittings, etc.).
 - 5. Make water system modifications as required by the balancing engineer.
 - 6. Clean air filters, ductwork, coils, fans, etc. in the air system to remove all construction dust and debris.
 - 7. Start, lubricate and balance all fans. Change and/or adjust drive pulleys on fans to give required RPM.

8. Supply and install balancing dampers as required for final balancing as determined by the balancing engineer.
9. Furnish workmen familiar with this project and of the proper trade to assist the balancing engineer in the air and water balancing. Also make available subject to request by the balancing engineer trained servicemen of the control, and other equipment suppliers to assist as needed during the testing of their portion of the project.
10. Furnish plans, operating manuals, and shop drawings of all equipment installed for use by the Air and Water Balancing Agency.
11. Have all systems in full operation a minimum of 72 hours before Balance Contractor arrives on job.

PART 2 - PRODUCTS

2.1 TESTING AND BALANCING:

- A. The Mechanical Contractor shall procure the services of a Professional Engineer and Contracting Officer approved independent test and balance agency to test water and air moving equipment and air distribution and exhaust systems and to supervise the balance and adjustment of these systems. All work shall be done under direct supervision of a qualified Heating and Ventilating Engineer. The Contractor shall provide access as required, including any necessary scaffolding, and shall cooperate with testing laboratory personnel. All instruments used in this work shall be accurately calibrated within the 9 months prior to initiating work, and maintained in good working order. If requested the tests shall be conducted in the presence of the Mechanical Engineer responsible for the project and/or his representative. Air balance and testing shall not begin until the system has been completed and is in full working order. The Contractor shall award the test and balance contract upon receipt of his contract to proceed with the air conditioning installation, to allow the Air Balance and Testing Engineer to schedule his work in cooperation with other trades involved and comply with completion date. Upon completion of the air conditioning system installation, the Air Balance and Testing Engineer shall perform the following tests, supervise adjustments and system modifications, and compile the test data as required for evaluation and approval.

- B. The independent test and balance agency shall be a full member in good standing of either NEBB or AABC. All work shall be performed in accordance with the standards set forth by either NEBB or AABC.
- C. Submit a pre-balance check list of items to be performed by the Mechanical Contractor prior to balance.
- D. Submit a test and balance agenda outlining methods, procedures and instrumentation to be used during balancing. This agenda shall be submitted within 3 months after award of the building contract.
- E. Perform an opposite season check-out of the HVAC system (Air and Water) approximately 6 months after original balance to verify that all systems are operating properly and adjust as required. Submit report to the Contracting Officer.

PART 3 - EXECUTION

3.1 AIR SYSTEM TEST AND BALANCE PROCEDURE:

- A. Bring all fans to design RPM.
- B. Bring air volume in each air handling system to the design air volume using pitot tube transverse method.
- C. Test and record fan motor data.
- D. Test and record static pressure and air volume in high velocity duct extremities.
- E. Measure, record and adjust air diffusers and registers to design CFM.
- F. Make recommendations for system modifications and adjustments required to facilitate proper system balancing as determined by preceding test.
- G. Perform duct pressurization tests as specified in Section 15891.
- H. Retest and readjust all system segments affected by system modifications.

3.2 WATER SYSTEM TEST AND BALANCE PROCEDURE:

- A. Review systems, automatic fill valve and strainer, expansion tank level, water cleanliness, pump strainers, air vent location and pressure tap locations.
- B. Inform Mechanical Contractor if there is additional work required by the Contractor prior to balancing.
- C. Measure circulating pump capacities using calibrated flow meter. Record differential pressure and dead head measurements, amperage and voltages. Position all automatic valves, hand valves and balancing cocks for full flow through coils, converters, etc. during pump adjustment. Use only calibrated test gages for pump adjustment; the use of pressure gages installed with the system will not be allowed.
- D. Coordinate the setting of controls to maintain coil water inlet design temperatures, with coil valves positioned for full flow through coil during adjustment. Balance individual water coils at full flow to maintain temperature differential specified.
- E. Test all equipment on the water system (coils, pumps, converters, etc.) for design flow.
- F. Mark settings of all balancing cocks at required positions.

3.3 DATA FILE:

- A. Prepare complete balance report, and data file on all equipment and devices tested indicating name plate data, design requirements and final operating conditions. Prepare drawing showing final CFM adjacent to each supply, return, and exhaust device. Submit seven (7) copies of the final balance report to be distributed as follows:

General Contractor	- 1 copy
Mechanical Contractor	- 1 copy
Architect	- 1 copy
Engineer	- 1 copy

Remaining three (3) copies to be included in the operation and maintenance manuals presented to the Contracting Officer.

- B. Final report shall include stamp and/or seal of NEBB or AABC certified member.

3.4 RETESTING

- A. Perform all necessary retesting and rebalancing required to bring all systems into compliance with design parameters of $\pm 10\%$ on airflow and $\pm 5\%$ on water flow, at the pump and $\pm 10\%$ on water flow at the terminal device.
- B. Perform all retesting necessary after contractors rework to bring non-conforming systems into compliance.
- C. Perform all retesting and readjusting as requested by engineer after review of test report and submit revised report as required.

3.5 INSTRUCTION:

- A. At the completion of the balancing, review the operating and maintenance brochures as supplied by the Mechanical Contractor supplement these instructions as determined through balancing experience. Meet with owners personnel and with Mechanical Contractor and controls subcontractor to review proper operating procedures.
- B. Warranty that the system is set in accordance with values as established by the plans and specifications.

END OF SECTION 15990

ELECTRICAL INDEX

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SECTION 16050 - BASIC METHODS AND REQUIREMENTS (ELECTRICAL)

PART 1 - GENERAL

1.1 GENERAL CONDITIONS:

- A. The General Conditions, Supplementary General Conditions, General Requirements, and Special Conditions shall be and are hereby made a part of this Section of the specifications.
- B. In case of conflicts between the electrical drawings and Division 16 of these specifications, the more stringent requirements shall govern. In all cases, notify the project engineer for direction.
- C. The requirements of SECTION 16050 - BASIC METHODS AND REQUIREMENTS establish minimum requirements, apply to, and are hereby made a part of all sections of Division 16 of this specification.
- D. The contractor shall be responsible for excavation of all earth, soil, and rock conditions at the site. Review the elevations and soil boring logs and include all associated costs.

1.2 DESCRIPTION:

- A. The electrical work shall include all labor, materials, tools, transportation, equipment, services and facilities, required for the complete, proper and substantial installation of all electrical work shown on the plans, and/or outlined in these specifications. The installation shall include all materials, appliances, and apparatus not specifically mentioned herein or noted on the drawings but which are necessary to make a complete working installation of all electrical systems.
- B. All of the electrical related work required for this project (unless specified otherwise) is a part of the Electrical Contract price but is not necessarily specified under this division of the specifications or shown on the electrical drawings. Therefore, all divisions of the specifications and all drawings shall be consulted.
- C. The floor plan drawings are schematic only and are not intended to show the exact routing of raceway systems unless dimensions are noted on the drawings. Final routing will be governed by field conditions (structural members, mechanical equipment, ductwork, etc.) and shall be determined by the contractor and approved by the architect. Any changes in routing shall not change the design of the raceway system.

- D. The floor plan drawings showing device and equipment locations are schematic only and are not intended to show exact locations unless dimensions are noted on the drawings. The contractor shall review all contract drawings that may affect the location of devices and equipment to avoid possible interference and permit full coordination of all work. The right to make any reasonable change in location within 6'-0", is reserved by the architect up until the time of rough-in at no extra cost.
- E. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of transformers, cable, switchgear, panelboards, motor control, and other items, arrangement for specified items in general are shown on drawings.
- F. Electrical service entrance equipment (arrangements for temporary and permanent connections to the power distribution system) shall conform to **Texas National Guard requirements**. Coordinate fuses, circuit breakers and relays with the power distribution system, and obtain approval from SANGB MI Utility Supervisor. Provide all required temporary building power and lighting. Remove when finished. Installation of temporary power and lighting shall comply with N.E.C. and OSHA requirements.
- G. Ampacities specified or shown on the drawings, are based on copper conductors, with the conduit and raceways accordingly sized.

1.3 MINIMUM REQUIREMENTS:

- A. Codes Rules And Regulations: Execute all work under ADA the latest rules and regulations of the National Electrical Code Standard of the National Board of Fire Underwriters, the National Fire Protection Association, and with all laws, regulations and ordinances of the County, State, City, and the Utility Company.
- B. Codes shall govern in case of any direct conflict between codes and plans and specifications; except when plans and specifications require higher standards than those required by code. Variance from the plan and specifications made to comply with code must be approved by the architect. If approved they shall be made with no increased cost to the Government.

1.4 STANDARDS:

- A. All material and equipment shall be listed, labeled or certified by Underwriters Laboratories, Inc., where such standards have been established. Equipment and material which are not covered by UL

Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Certified: Equipment is "certified" if:
 - a. Equipment has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Production is periodically inspected by a nationally recognized testing laboratory.
 - c. It bears a label, tag, or other record of certification.
2. Nationally recognized testing laboratory: A testing laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.5 QUALIFICATIONS (PRODUCTS AND SERVICES):

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
 2. The engineer reserves the right to require the contractor to submit a list of installations where the products have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will respond within two hours of receipt of notification that service is needed. Submit name and address of service organization.

1.6 MANUFACTURED PRODUCTS:

- A. Materials and equipment furnished shall be new, of best quality and design, free from defects, of current production by manufacturers regularly engaged in the manufacture of

such items, for which replacement parts should be available. All items used on this project shall be free of asbestos, PCB, and mercury material.

- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer unless indicated otherwise.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall be completely responsible for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory and Field wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing is Specified:
 - 1. The engineer shall have the option of witnessing factory tests. The contractor shall notify the engineer a minimum of 15 working days prior to the manufacturer making the factory tests.
 - 2. Four copies of certified test reports containing all test data shall be furnished to the engineer prior to final inspection and not more than 90 days after completion of the tests.

3. When equipment fails to meet factory test and reinspection is required, the contractor shall be liable for all additional expenses, including expenses of the engineer.

1.7 EQUIPMENT PROTECTION:

- A. Equipment and material shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain.
- B. During installation, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter and be vacuum cleaned both inside and outside before testing, operating and painting.
- C. Damaged equipment shall be, as determined by the engineer, placed in satisfactory operating condition or be returned to the source of supply for repair or replacement.
- D. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
- E. Damaged paint on equipment and materials shall be restored to the original quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.8 GENERAL WORK REQUIREMENTS:

- A. Arrange, phase and perform work to assure electrical service both temporary and permanent for buildings at all times.
- B. Coordinate location of equipment and conduit with other trades to minimize interferences.
- C. Examination of Site:
 1. Visit the site, inspect the existing conditions and check the drawings and specifications so as to be fully informed of the requirements for completion of the work.
 2. Lack of such information shall not justify an extra to the contract price.

D. PERMITS:

1. Obtain and pay for all licenses and permits, fees, inspection and certificates required for the execution of this work.
2. Pay fees and charges for connection to outside services and use of property.
3. Deliver permits and certificates to the architect to be transmitted to the Government.

E. SERVICES:

1. This contractor shall pay for all expenses, deposits, reimbursements, etc., required by the local rules and codes for the service to the buildings, complete and ready for use. See plot plan.
2. Consult Texas National Guard Engineering Representative for their requirements and for coordinating installation. Contractor shall provide any work thus required beyond that indicated by the drawings and specifications. He shall bear all expense involved for the complete installation of the electrical service (both temporary and permanent) to the building ready for operation.
3. He shall consult all local departments to verify requirements and bid installation of service in accordance with local codes and SANGB MI rules and regulations.
4. He shall bear all expense involved for the complete telephone CATV and "LAN" System Fiber as detailed on the plans. Verify complete installation with SANGB MI Communications Supervisor and bid installation to comply with their requirements.

F. RESPONSIBILITY:

1. This contractor will be held responsible for any and all damage to any part of the building or to the work of other contractors, as may be caused through his operation.

2. Any mutilation of building finishes or equipment initiated by electrical construction shall be properly corrected by the respective finishing contractor and paid for by the Electrical Contractor.
3. The operation of the temporary power and the permanent electrical system shall be the responsibility of this contractor until acceptance of the building by the Government.

G. WORK TO BE DONE BY GENERAL CONTRACTOR:

1. Build in all openings sleeves, chases etc., for conduit and equipment as established, furnished and set by this contractor. He shall seal or grout all openings after this contractor has installed his conduits.
2. Build in bolts, brackets, hangers etc. for work established, furnished and set by this contractor.
3. All concrete work required for equipment furnished and set by this contractor including clean up pads under electrical gear, fixture bases, transformer bases, etc.
4. Painting: All painting of electrical equipment installed in finished areas shall be done by the general contractor. Painting will not be required on receptacles, switches, circuit breakers etc. All fixtures and exterior poles specified to be factory-primed shall be painted by general contractor. Paint all wiremold, exposed conduit and equipment, etc. to match final wall colors.
5. Provide fireproofing above fixtures located in fire rated ceilings per U.L. requirements.
6. Pay all utility costs for operation of electrical system during construction until acceptance of building by the Government.

H. WORK DONE BY THE MECHANICAL CONTRACTOR:

1. The mechanical contractor shall furnish wiring diagrams and temperature control drawings of all equipment furnished to the electrical contractor. Catalog information is unacceptable, provide point to point drawings.

2. The mechanical contractor shall furnish and install all control equipment requiring connections to air, water, steam, etc., such as pneumatic electric relays, remote bulb temperature controls, solenoid valves, aquastats and pressure controls.
3. The mechanical contractor shall reimburse the electrical contractor for any changes in system design i.e.; control or equipment which effects the electrical contractor. Also refer to equipment connections, controls and instrumentation in 16050.

I. WORKMANSHIP AND COORDINATION:

1. Make installation substantially as shown on the plans.
2. Make alterations in location of apparatus or conduit as may be required to conform to building construction without extra charge.
3. Mechanical equipment service clearances and electrical apparatus service clearances as specified in their respective manufacturer's product data shall be maintained free from conduit.
4. Cooperate with other trades in their installation of work.
5. Complete the installation in a workmanlike manner, completely connected and ready to give proper and continuous service.
6. Use only experienced licensed electricians.

J. CUTTING AND PATCHING:

1. Notify the general contractor in ample time, of the location of all chases, sleeves, and other openings required in connection with the work of this contract.
2. Cutting and patching made necessary because of failure to comply with the above shall be done by the general contractor at the expense of the electrical contractor.
3. When it is necessary for the electrical contractor to cut building materials to install his work, it shall be done in a neat and workmanlike manner meeting with the approval of the architect.

4. Holes through concrete shall be carefully drilled with a "Concrete Termite" drill. A Star drill or Air Hammer will not be permitted. Structural members shall not be cut without approval from the architect.
5. Any penetrations thru the roof shall be made with flashing connections approved by the roof system manufacturer or as approved by the architect.
6. Any penetrations made in exterior or basement foundation walls shall be sealed with Thunderline "Link-Seal" connections, as manufactured by Thunderline Corporation, Wayne, Michigan.

K. MANUFACTURER'S INSTRUCTIONS:

1. Apply, install, connect, erect, use, clean, and condition articles, materials and equipment as directed by the manufacturer.

1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS:

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working spaces shall not be less than specified in the National Electrical Code for all voltages specified.
- C. Inaccessible Equipment:
 1. Where the engineer determines that the contractor has installed equipment without proper clearances or not readily accessible for operation and maintenance, equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 - a. Install access panels as approved by the architect to provide access to all equipment, J-boxes and outlets located in non-accessible spaces. Panels shall be flush locking type with a fire rating equal to the ceiling system.

2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping, and ductwork. Outlet and box covers shall be removable by using regular length (8") screw drivers.

D. Distribution Equipment:

1. All items of Electrical Distribution Equipment (switchboards - panelboards - disconnects) shall be of one manufacturer, unless specifically noted on the drawings, in the specifications, or approved by the engineer. Intermixing of distribution equipment by different manufacturers will not be permitted.
2. Provide a surge arrester for lightning protection on each service entrance for each building. Refer to drawings for voltage and phasing of service. Arrester shall be located within the main switch, panel or switchboard enclosure. Surge Arrester: shall be injection molded high temp. thermoplastic utilizing metal oxide varistors with a fusible link and an LED indicating light.
 - a. 277/480V.: Voltage rating line to ground shall be 650V. RMS min. Response time shall be instantaneous. Max. clamping voltages shall be 1800 volt at 1500 Amps line to ground, 2500 volt at 5,000 Amps line to ground, 3,400 volt at 10,000 Amps line to ground. Minimum life at 1.5 KA is 2,500 operations. 36,000 Amp peak single pulse transient. Square 'D' #SDSA3650.
3. Equipment layouts on the drawings are based on one manufacturer. Verify all actual equipment sizes with equipment manufacturer prior to bidding.
4. If layout changes are required due to differing electrical manufacturers equipment size, they must be submitted to and approved by the engineer. National Electric Code working clearances must be maintained at all times. Extra remuneration will not be allowed for layout changes that differ from those shown.
5. Provide and install all steel supports as required for mounting of electrical equipment.
6. Anchor all free standing electrical equipment including switchboards, switchgear, substations, motor control centers, paralleling gear, transfer switches, transformers, etc. to the floor with plated, 1/2" diameter minimum, anchor bolts or as recommended by the manufacturer.

1.10 EQUIPMENT CONNECTIONS, CONTROLS AND INSTRUMENTATION:

- A. General: The following applies to all electrical power and control connections for all equipment requiring electrical installation work provided by others.
- B. Electrical contractor shall install and connect the following items for equipment requiring electrical power that is either furnished or specified by other contractor and/or the Government. Where these required items are not furnished with the equipment being connected. It shall be the electrical contractor's responsibility to provide the necessary items including conduit boxes and wiring.
 - 1. Starters
 - 2. Disconnecting Devices
 - 3. Thermal Overload Devices
 - 4. Overcurrent Devices
 - 5. Short Circuit Protective Devices
 - 6. Power Factor Correction Devices
 - 8. Voltage Transformation Equipment
 - 9. Control Devices (Local and Remote)
 - 10. Audible and Visual Control Status Annunciation Devices
 - 11. Equipment Mounting Structures
 - 12. Additional Miscellaneous Devices

In general all major equipment will be specified to be factory prewired with only service and interconnecting wiring required at the site by the electrical contractor; however, he shall check all divisions of the specification to verify if the equipment is specified factory prewired and if not, then it shall be the responsibility of the electrical contractor to provide the complete wiring of the equipment in accordance with wiring diagrams provided by other contractors and/or Government to the electrical contractor. All interconnecting of equipment shall be by the electrical contractor.

- C. All line and low voltage wiring and connections required to control the equipment are a part of this section. All wiring shall be in conduit. When mechanical controls are to be provided by a Temperature Controls Contractor (TCC), low voltage control wiring for the control system shall be provided by the TCC and installed by the Electrical Contractor. Terminations will be made by TCC.
- D. The electrical contractor shall provide 120 volt control power supply; #12 Ga. CU. THHN/THWN in 1/2" C. minimum at all points required by controls, instrumentation and sprinkler risers. Circuit as shown on the plans or to the nearest 120 volt panel if no circuiting is indicated. Use spare 20 Amp. breakers. Each control panel shall be on a separate circuit unless otherwise indicated. If the controlled equipment is fed from the emergency system, then the control power supply must feed from the emergency system.

- E. The contractor shall familiarize himself with the equipment to be furnished by the other contractors and/or the Government in connection with this work and that provisions for such connections and work has been included in the contractor's price. Extra remuneration will not be allowed for such work.
- F. Connections to all equipment have been designed from units as specified on the drawings or in the specifications. In the event equipment or control differs on approved shop drawings it shall be the responsibility of the supplying contractor to coordinate electrical connections to the units and reimburse electrical contractor for any changes in system design. These changes shall not involve additional cost to the Government.
- G. Review all plans and specifications to verify all equipment connections that are required by mechanical and/or other contractors. Although the electrical drawings will show equipment connection requirements, it is the electrical contractor's responsibility to connect all equipment furnished by other contractor's at no extra cost to the Government even if this equipment connection is not shown on the electrical drawings. Coordinate all required connections not shown on the electrical drawings with the engineer.

1.11 NAMEPLATES:

- A. General: The following items shall be equipped with nameplates:
 - 1. Disconnect switches (fused or nonfused), transformers, switchgear, switchboards, panelboards, separately mounted circuit breakers, starters, contactors, relays, junction boxes and pull boxes.
 - 2. Special Electrical Systems (fire alarm, sound system, etc.) shall be so identified at junction and pull boxes, terminal cabinet and equipment racks.
 - 3. Wall switches or other control devices controlling equipment or special lighting configuration.
 - 4. All devices on the emergency system shall be 'Red' with red plates labeled "Emerg."
- B. Inscription: Nameplates shall adequately describe the function or use of the particular equipment involved. Nameplates for panelboards and switchboards shall include the panel designation, voltage, phase, A.I.C. rating of the supply (see schedules, one-line diagram, and color coding). For example, "Panel A" 120/208 V, 3-Phase, 4-Wire, 10,000 A.I.C.":

Phase A - Black
Phase B - Red
Phase C - Blue
Neutral - White
Ground - Green

The name used for a machine nameplate shall be the same as the one used on the machine's motor starter, disconnect and P.B. station nameplates. Nameplates for fused switches and panels shall also indicate fuse type and size. All panelboards fed from the emergency system shall be labeled "Emergency System", in addition to the instructions listed above.

- C. Construction: Nameplates shall be laminated phenolic plastic white front and back with black core. Nameplates for emergency system panelboards and transfer switch shall be laminated phenolic plastic red front and back with white core. Lettering shall be engraved through front layer to form 1/4" black characters. Nameplates shall be securely fastened to the equipment to be identified, with No. 4 Phillips, round head, cadmium plated, steel self tapping screws or nickel plated brass bolts. Motor nameplate may be nonferrous metal not less than 0.03 inches thick, die stamped. In lieu of separate plastic nameplates, engraving directly on device plates is acceptable. Letters engraved thus, shall be filled with contrasting enamel. All nameplates and their installation are part of this work. Free hand lettering or dymo label marker will not be acceptable, except for separately mounted disconnect switches, circuit breakers, starters and similar separately mounted devices.

1.12 MATERIALS OF APPROVED EQUAL:

- A. Where items of equipment and/or materials are specifically identified herein by a manufacturer's name, model or catalog number, only such specific items may be used in the base bid, except as hereinafter provided.
- B. Unless requests for changes in base bid specifications are received, approved and noted by written addendum prior to the opening of bids, the successful contractor will be held to furnish specified items.
- C. After contract is awarded, changes in specifications shall be made only as defined under "Substitution of Equipment".

1.13 SUBSTITUTION OF EQUIPMENT:

- A. After execution of the contract, substitution of equipment of makes other than those specifically named in the contract documents may be approved by the engineer only if the equipment named in the specifications cannot be delivered to the job in time to complete the work in proper sequence to work of other contractors, due to conditions beyond control of the contractor. Provide documentary proof in writing from the manufacturer that the specified equipment will not be available in time. If the contractor is responsible for the delay, the substitution will not be approved.
- B. Requests for substitutions must be accompanied by documentary proof of equality or difference in price and delivery, if any, in form of certified quotations from suppliers of both specified and proposed equipment.

1.14 SUBMITTALS: In accordance with Section SUBMITTALS, furnish the following:

- A. The engineer's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- B. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the engineer to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- C. Submittals shall be complete and submitted together for each section. Individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assemble as a whole. Partial submittals will not be considered for approval.
 - 1 Mark the submittals, "SUBMITTED UNDER SECTION_____". Mark out all statements on sheets that do not apply otherwise. The engineer may select options and equipment not originally specified. All options that are not marked out will be assumed that the contractor will furnish the same.
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
 - 4. Mark catalog cuts to indicate equipment, capacities, finishes, sizes, etc. Each individual item shall have its own sheet provided for approval. (Example: Separate sheets for each panelboard.)
- D. The submittals shall include the following:
 - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 - 2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.

3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
 4. Quantities of materials will not be verified by the architect or engineer. Approval stamp on shop drawings does not constitute approval of quantities listed on shop drawings.
 5. Shop drawings:
 - a. All shop drawings shall be checked and signed by this contractor and general contractor prior to submittal to the architect/engineer.
 - b. Shop drawings submitted without contractors signatures or approval and verification will not be approved.
 - c. Shop drawings shall be submitted on wire, cables, devices, lighting fixtures (including distribution curves), motor starters, panelboards, disconnects, substations, transformers, switchgear, switchboards, motor control centers, conduit, raceway systems, all systems, etc.
 6. Each sheet shall be either 8 1/2" x 11"; 8 1/2" x 13"; or 11" x 17" bond with a 5" x 3" clear area for engineers stamp. (This area shall not be used by this contractor or the generals stamp.) Larger drawings shall be able to be blue printed.
 7. Submittals for all systems (fire alarm, security, PA, controls, etc.) shall include complete riser diagrams showing all conductors and conduit sizes.
- E. Engineers acceptance of Compliance Submittals will not relieve the contractor from his responsibility for any deviations from the requirements of the contract documents unless contractor has in writing called engineer's attention to such deviation at the time of submission and engineer has given written approval to the specific deviation, nor shall any acceptance by engineer relieve contractor from responsibility for errors or omissions in Compliance Submittals.
- F. Quantity of Submittals: See the general specification sections and AF Form 66.

1.15 ELECTRICAL WORK COMPLETION:

- A. Before requesting final inspection the following work must be completed.

B. Operating Instructions:

1. The contractor shall submit along with the shop drawings of the equipment, three (3) copies of operating instructions for all items. Instructions shall be prepared by the manufacturer of the equipment. Verify quantity with Architect.
2. After the operating instructions have been approved by the engineer, the contractor shall include the remaining three copies in maintenance instructions brochures.
3. The contractor shall also obtain all manufacturer's instructions, manuals, and one complete set of drawings and turn these over to the architect at the completion of the project.
4. The contractor shall keep in a safe place, all keys and special wrenches furnished with equipment under this contract and shall give same to the architect at the completion of the project.
5. The contractor shall prepare a complete brochure, in triplicate, covering all systems and equipment furnished and installed under his contract. Brochures shall be submitted to the architect-engineer for approval and delivery to the Government. The cost of this brochure shall be included in the contract cost. Brochures shall contain the following:
 - a. Certified equipment drawings and/or catalog data clearly marked for equipment furnished as required for approval submission under detailed section of the specifications.
 - b. Complete operating and maintenance instructions for each item of equipment.
 - c. Complete part list for each equipment item.
 - d. Any special emergency operating instructions or a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.
6. Brochures shall be bound in hard backed three ring binders with an index, subdividers and reinforced sheets.
 - a. Project name and address.
 - b. Section of work covered by brochure, i.e. "Electrical Work".
 - c. Name and address of architect.
 - d. Name and address of engineer.
 - e. Name and address of contractor.
 - f. Telephone number of contractor, including night or emergency number.

7. In addition to these written instructions, each respective contractor shall fully and carefully instruct the Government, or his selected representatives, as to the proper operation, care and maintenance of each system and its equipment.
8. Fire Alarm, Security, Sound, PA, Clock, etc., Systems: The manufacturer shall conduct a device by device test. Verify completely proper operation. Record all items checked for each device and device location on a form. Submit this final checkout form to the engineer.

1.16 TESTING AND ADJUSTMENT:

- A. Record loads on each phase of all panelboards, distribution panels, switchboards, transformers and submit final readings to the architect for records. This contractor shall adjust equipment, instruments, gages, meters etc., as required to test and adjust these systems.
- B. Check, test, and adjust the mechanisms of all electrical equipment and adjustable parts of lighting fixtures as required for optimum performance.
- C. Perform tests for insulation resistance in accordance with the requirements of the National Electrical Code and insure that all circuits are free from short circuits.
- D. Keep a calibrated voltmeter and ammeter available at all times and provide service for test readings when and as required up until the project is accepted by the Government.

1.17 AS-BUILT DRAWINGS:

- A. Show on blue line prints in red ink all changes from original plans made during the installation. Return two (2) sets of red marked drawings, specifications and addenda, as set forth in the General Conditions, to the architect upon completion of the project.

1.18 FINAL INSPECTION:

- A. Final inspection will be made upon written request from the general contractor after the project is completed.

- B. Furnish a workman familiar with this project to accompany the engineer on final inspection and have available ladders, drop cords, and other equipment as required to gain access to any portion of this system.
- C. This contractor and his principal subcontractors shall be represented at the inspection by a person of authority responsible to demonstrate to the engineer that his work conforms to the intent of the plans and specifications.
- D. Extra inspections made necessary by the electrical contractor's failure to comply with the conditions as set forth above shall be charged to the contractor for the inspector's time both on the job and spent in travel between the office and the project site.

1.19 GUARANTEE:

- A. Guarantee all work, material and equipment for a period of one year after date of substantial completion.
- B. During the one year guarantee period the electrical contractor shall be responsible for any defects which develop in the electrical systems. Upon notification of a defect by the general contractor he shall make immediate effort to correct it and shall notify the architect when this work is completed. This guarantee does not include ordinary lamp failure.
- C. Repairs and/or replacements shall be made with no cost to Government.
- D. Provide as part of the work of this contract, in addition to the first year's guarantee on equipment and materials, the following routine maintenance and inspection. (The one year time period will not start until each item is completed in accordance with plans and specifications and accepted by the Government). Correct and adjust all emergency systems, controls, fire alarm, transformer, etc. This service to be provided throughout the guarantee period.

1.20 SINGULAR NUMBER:

- A. Where any device or part of equipment is referred to in these specifications in the singular number (such as "the switch"), such reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.21 SPECIAL SYSTEMS

- A. Equipment and wiring for special systems shall be as shown in the following schedule:

SYSTEM	EQUIPMENT FURNISHED BY	EQUIPMENT INSTALLED BY	WIRING FURNISHED AND INSTALLED BY
Communications	Government	Government	Contractor
Telephone	Government	Government	Contractor
Television	Government	Government	Government
Public Address	Contractor	Contractor	Contractor
Fire Alarm	Contractor	Contractor	Contractor

- B. Power wiring for all systems shall be furnished and installed by the contractor as shown on the drawings and as required by the equipment manufacturer.
- C. Low voltage outlets shall be installed for all systems as shown on the drawings and shall be as specified for telephone outlets, hereinbefore, or as otherwise shown or required by the application or by the equipment manufacturer.
- D. Telephone, CATV, communications and fire alarm systems shall be completely installed in separate conduit systems. All cable for these systems shall be in conduit and shall not be combined with any other system cable. Conduits systems shall be furnished and installed by the Electrical Contractor.
- E. Conduits shall be sized as required by the number and type of conductors applied and/or as noted on plans (min. 3/4") and shall be not smaller than sizes recommended by the equipment manufacturer. All conduits shall be labeled to identify which system it is to be used for i.e.: Fire Alarm, Telephone, P.A. Etc.
- F.. Typically ceiling voids in the building are not used as air plenums and wiring in these ceiling voids is not required to be fire rated for such service. However when ceiling voids are used as air return plenums, only U.L. Listed plenum cable (Where cables are not required to be in conduit) shall be used or non-rated cables shall be completely routed in conduit.
- G. Any low voltage wiring installed in ceiling voids shall be bundled, neatly routed, suspended above the grid system or with appropriate tags as to service.
- H. Low voltage wire and cable shall be specifically designed to function with equipment supplied. Cable shall be color coded for ease of installation and service, twisted, shielded, and grounded for control of voice circuits and covered with wear-resistant moisture proof protective insulation. Wire shall bear manufacturer's trademark either embossed or printed on cable.

END OF SECTION 16050

SECTION 16110 - RACEWAY SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes the furnishing, installation, and connection of raceways, fittings, and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: the term conduit, as used in this specification, shall mean any or all of the raceway types specified.

PART 2 - PRODUCTS

2.1 MATERIAL:

- A. Raceway Size: In accordance with the NEC but not less than 1/2-inch unless otherwise shown. Where permitted by the NEC, 1/2-inch flexible conduit may be used for tap connections to recessed lighting fixtures.
- B. Raceways: Install raceway types as shown on drawings and as listed below.
 - 1. Rigid steel: UL 6.
 - 2. Rigid aluminum: Fed. Spec. WW-C-540.
 - 3. Rigid intermediate steel conduit (IMC): UL 1242.
 - 4. Electrical metallic tubing (EMT): U.L. 797. Maximum size 5-inch. Permitted only with cable rated 600 volts or less.
 - 5. Flexible steel conduit (commercial greenfield): Fed. Spec. WW-C-566 and UL 1.
 - 6. Liquid-tight flexible metal conduit: Flexible galvanized steel tubing covered with extruded liquid-tight jacket of polyvinyl chloride (PVC). Provide conduit with a continuous copper bonding conductor spiral between the convolutions.
 - 7. P.V.C. Conduit: UL approved Schedule 40, minimum 3/4" C. When PVC conduit is used, a ground wire sized per NEC 290-95 shall be added if not already specified.

C. Conduit Fittings:

1. Rigid steel and IMC conduit fittings:

- a. Standard threaded couplings, locknuts, bushings, and elbows: Fed. Spec. W-F-408, except only material of steel or malleable iron are acceptable. Integral retractable type IMC couplings are acceptable also.
- b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure
- c. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted. Bushings for conduit smaller than 1 1/4" shall have flared bottom with ribbed sides.
- d. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
- e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank coverplates having the same finishes as that of other electrical plates in the room.
- f. In trade sizes 2-1/2" to 4" for rigid steel raceway or intermediate metal raceway, contractor may use Allied 'Kwik-Couple' fittings in lieu of individual steel couplings. 'Kwik-Couple' fittings shall not be used in hazardous locations. Where 'Kwik-Couple' fittings are used exterior for vertical risers, install fitting with taper end up.

2. Rigid aluminum conduit fittings:

- a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials. Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.

- b. Locknuts and bushings: As specified for rigid steel and IMC raceways.
 - c. Set screw fittings: Not permitted for use with aluminum raceway.
3. Electrical metallic tubing fittings:
- a. Fed. Spec. W-F-408, except only material of steel for compression type. Steel or die-cast is acceptable for set screw type. Die-cast compression is not acceptable.
 - b. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated flared throats. Use gland and ring compression type or set screw type couplings and connectors for conduit smaller than 2 inches. Use set screw type couplings with four set screws each for conduit sizes 2 inches and larger. Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
 - c. Indenter type connectors or couplings are prohibited.
4. Flexible steel conduit (greenfield) fittings:
- a. Fed. Spec. W-F-406 and UL 5, except only steel or malleable iron material is acceptable.
 - b. Clamp type, with insulated throat.
5. Liquid-tight flexible metal conduit fittings:
- a. Fed. Spec. W-F-406, except only steel or malleable iron material is acceptable.
 - b. Type incorporating a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
6. Expansion and deflection couplings:
- a. UL 467 and UL 514.
 - b. Accommodate, 1.9 cm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.

- c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
- d. Shall be watertight, seismically qualified, corrosion-resistant, threaded for and compatible with rigid or intermediate metal conduit.
- e. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

D. Raceway Supports:

- 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
- 2. Pipe Straps: Fed. Spec. FF-S-760, Type I, Style A or B.
- 3. Individual Raceway Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
- 4. Multiple Raceway (trapeze) hangers: Not less than 1-1/2 by 1-1/2 inch, 12 gage steel, cold formed, lipped channels; with not less than 3/8-inch diameter steel hanger rods.
- 5. Solid Masonry and Concrete Anchors: Fed. Spec. FF-S-325; Group III self-drilling expansion shields, or machine bolt expansion anchors Group II, Type 2 or 4, or Group VIII.

E. Outlet Boxes:

- 1. UL-50, UL514A, Fed. Spec. W-C-586 and Fed. Spec. W-J-800.
- 2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
- 3. Sheet metal boxes: 4" square, galvanized steel, except where otherwise shown.
- 4. Boxes installed in concrete or masonry and boxes larger than 2 gang shall be masonry type.

- F. Wireways: Equip with hinged covers, except where removable covers are shown.
- G. Pull and Junction Boxes:
 - 1. Pull and junction boxes shall be code gauge steel boxes with hinged, bolted or screwed covers. Boxes shall be flush or surface mounted as shown or required.
 - 2. Junction and pull box shall be installed where shown on drawings and additional boxes shall be installed if required for pulling of wire provided location and installation is approved by the architect. All boxes shall be code construction with screw type cover and shall be installed in accessible locations.

PART 3 - EXECUTION

3.1 RACEWAY:

- A. A ground wire, sized per NEC 250-95 shall be pulled in all conduits containing phase conductor(s).
- B. Rigid galvanized steel (RGS) or IMC must be used at all times when exposed to weather or physical abuse and in all NEC classified hazardous locations. EMT may not be used in direct contact with earth, or in concrete slabs on grade.
- C. U.L. approved Schedule 40 P.V.C. conduit may be used where feeders or branch circuits are to be run in earth or slabs (3/4" minimum). Use RGS ells and risers W/PVC coating approved for underground use. All conduit risers through concrete floors shall be RGS from below the top of the floor slab. Use conduit adapters when converting from P.V.C. to steel conduit. Use plastic spacers when more than one conduit is installed together. Spacers shall be installed per the NEC table 347-8. See Drawings for areas requiring concrete encasement. All P.V.C. conduits shall be provided with separate ground conductor sized per N.E.C..

3.2 PENETRATIONS:

- A. Cutting or Holes:
 - 1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Structural Engineer prior to drilling through structural sections.
 - 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Structural Engineer as required by limited working space.

B. Fire Stop:

1. Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases, and maintains specified fire rating. Completely fill and seal clearances between raceways and openings with the fire stop material.

C. Fire Barrier Penetration Seals:

1. Manufacturer: Subject to compliance with requirements, provide fire barrier penetration seals of one of the following:

Electro Products Div./3M
Nelson; Unit of General Signal.

2. Provide seals for any opening through fire-rated walls, floors or ceilings used as passage for components such as conduits or cables.
3. Cracks, voids or holes up to 4" diameter: Use putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat and UL-listed.
4. Openings greater than 4" diameter and raceway sleeves thru floors at telephone terminal boards: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250°to 350°F (121 to 177·C), that is UL-listed. KBS "Sealbags" manufactured by P-W Industries will be acceptable.
5. Execution: Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions. All fire barrier seals shall meet the rating of the wall.
6. ENT penetrations shall use through - penetration firestop systems per UL.

D. Waterproofing:

1. At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section, SEALING AND CAULKING.

3.3 CONDUIT SYSTEMS INSTALLATION, GENERAL:

- A. Installation: In accordance with UL, NEC, as shown, and as hereinafter specified.
- B. Essential (Emergency) raceway systems: Install entirely independent of other raceway systems. Common supports and hangers may be used.
- C. Raceway Burial Depths: (Underground work)
 - 1. 18" minimum, 30" maximum cover to grade or bottom of floor slab.
 - 2. 24" minimum under streets, highways, roads, alleys, driveways and parking lots.
 - 3. 2" below concrete slab inside a building.
- D. Install raceways as follows:
 - 1. In complete runs before pulling in cables or wires.
 - 2. Flattened, dented, or deformed raceways is not permitted. Remove and replace the damaged raceways with new undamaged material.
 - 3. Assure raceway installation does not encroach into the ceiling height head room, walkways, or doorways.
 - 4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
 - 5. Mechanically and electrically continuous.
 - 6. Independently support raceway. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, mechanical piping, or mechanical ducts.). Group raceways with common supports where possible. Conduit shall be supported within 12 inches of connectors.
 - 7. Close ends of empty raceway with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
 - 8. Raceway installations under fume and vent hoods are prohibited.
 - 9. Secure raceways to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For RGS and IMC raceway installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make raceway connections to junction box covers.

10. Flashing of penetrations of the roof membrane is specified in Section, FLASHING AND SHEET METAL.
11. Raceways shall not be used as a support.

E. Raceway Bends:

1. Make bends with standard raceway bending machines.
2. Raceway hickey may be used for slight offsets, and for straightening stubbed out raceways.
3. Bending of raceways with a pipe tee or vise is prohibited.

3.4 CONCEALED WORK INSTALLATION:

A. General:

1. Raceway and Outlet Boxes Installation: All raceway systems work and outlet boxes shall be installed concealed in walls, floor and roof construction or concealed within furred spaces or above ceilings. In equipment or mechanical rooms exposed work shall include feeders and connections to equipment unless noted otherwise.

B. In Concrete:

1. Raceway: RGS, IMC, PVC or EMT; except do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run raceways in direct lines.
3. Install raceways through concrete beams only when the following occurs:
 - a. Where shown on the structural drawings.
 - b. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of raceways in concrete that is less than three inches thick is prohibited. All raceways installed in concrete shall be approved by the Structural Engineer.
 - a. Raceway outside diameter larger than 1/3 of the slab thickness is prohibited.

- b. Space between raceways in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
 - c. Install raceways approximately in the center of the slab so that there will be a minimum of 3/4-inch of concrete around the raceways.
 - 5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the raceways. Tightening set screws with pliers is prohibited.
- C. Above Furred or Suspended Ceilings and in Walls:
 - 1. Raceways for conductors 600 volts and below:
 - a. RGS, IMC, rigid aluminum, or EMT. Types mixed indiscriminately in the same system is prohibited.
 - b. Do not use aluminum in wet locations or in contact with concrete.
 - 2. Raceways for conductors above 600 volts:
 - a. RGS or rigid aluminum. Do not use aluminum in wet locations or in contact with concrete.
 - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
 - 3. Align and run raceways parallel or perpendicular to the building lines.
 - 4. Connect recessed or lay-in lighting fixtures and all other devices installed in a lay-in ceiling to raceway runs with flexible metal conduit extending from a junction box to the fixture. Provide a ground wire in all flexible conduits.
 - 5. Tightening set screws with pliers is prohibited.

3.5 EXPOSED WORK INSTALLATION:

- A. Raceways for Conductors 600 volts and below:
 - 1. RGS, IMC, rigid aluminum, or EMT. Types mixed indiscriminately in the system is prohibited.
 - 2. Do not use aluminum in wet locations or in contact with concrete.

3. All raceways exposed to physical abuse and in all industrial pump, treatment plant locations shall be RGS, or IMC.
- B. Raceways for conductors above 600 volts:
1. RGS or rigid aluminum. Do not use aluminum in wet locations.
 2. Aluminum mixed indiscriminately with other types in the same system is prohibited.
- C. Align and run raceways parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with raceway straps.
- E. Surface metal raceways: Use only where shown.
- F. Painting:
1. Paint exposed raceways as specified in Section, PAINTING.
 2. Paint raceways containing cables rated over 600 volts safety orange as specified in Section, PAINTING. In addition, paint legends, using two inch high black numerals and letters, showing the cable voltage rating. Provide legends where raceways pass through walls and floors and at maximum 20 foot intervals in between.

3.6 WET OR DAMP LOCATIONS:

- A. Unless otherwise shown, use raceways of RGS or IMC above grade. Use PVC conduit below grade, except feeders of 1/0 and larger, rigid galvanized steel ells and risers with PVC coating approved for underground use shall be used.
- B. Provide sealing fittings, to prevent passage of water vapor, where raceways pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces) or similar spaces.
- C. When RGS, IMC conduit or rigid galvanized steel ells and risers are used below concrete building slabs in contact with soil, gravel, or vapor barriers, cover conduit on the outside with a factory coating of 20 mil bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

3.7 MOTORS AND VIBRATING EQUIPMENT:

- A. Use liquid-tight Type UA flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit

3.8 EXPANSION JOINTS:

- A. Equip raceways three inches and larger, that are rigidly secured to the building structure on opposite sides of a building expansion joint, with expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide raceways smaller than three inches with junction boxes located 12 inches either side of the expansion joint. Connect junction boxes with 24 inches of slack flexible conduit. Flexible conduit shall have a insulated copper bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for three inches and larger conduits are acceptable.

3.9 RACEWAY SUPPORTS, INSTALLATION:

- A. All raceways shall have supports at maximum spacing of 10 feet and within 3 feet of a fitting, elbow, box outlet or enclosure. Safe working load shall not exceed 1/4 of proof test load of fastening devices. This shall apply to both vertical and horizontal conduit runs.
- B. Use pipe straps or individual raceway hangers for supporting individual conduits.
- C. Support multiple raceway runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the raceways, wires, hanger itself, and 200 pounds. Attach each raceway with U-bolts or other approved fasteners.
- D. Support raceways independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 1/4-inch bolt size and not less than 1-1/8 inch embedment.
 - b. Power set fasteners not less than 1/4-inch diameter with depth of penetration not less than three inches.
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted. Bolts supported only by plaster are not acceptable.
- G. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- H. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- I. Chair, wire, or perforated strap shall not be used to support or fasten conduit.
- J. Spring steel type supports "caddy clips" that are listed for the intended use are acceptable in appropriate locations.
- K. Vertical Supports: Vertical raceway runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.10 BOX INSTALLATION:

- A. Boxes for Concealed Raceways:
 - 1. Mount flush. Boxes protruding from the finished wall surface or with more than 1/8" gap between the wall or outlet mounted in the box will be changed out with all wall reconstruction expense paid by the electrical contractor.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.

- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited.
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is four inches square by 2-1/8 inches deep, with device covers for the wall material and thickness involved.
- F. Where lighting fixtures and appliance outlets are to be mounted in concrete or in plaster finish on concrete, outlet boxes shall be installed in forms at exact dimensions from bench marks, columns, walls or floors.
- G. Where lighting fixtures and appliances outlets are to be mounted on masonry walls and/or plastered furring or other finish, outlet boxes shall be roughed in to general location before installation of wall and furring and shall be reset to exact dimensions before walls and furring are constructed.
- H. All outlet boxes shall be set true to horizontal and vertical lines parallel to walls, floors and ceilings and true to finish lines. All boxes shall be secured to ceilings or walls so all installations are solidly mounted.
- I. Boxes mounted to wall studs shall be secured to a horizontal box mounting bracket Equal to B-Line Series #BB2 or #BB26. B-Line Series #BB4 or equal one piece support brackets may also be used for mounting boxes. However metal stud clips with farside box supports are not acceptable.
- J. Boxes for exterior exposed work (where approved by the engineer) shall be Appleton or Pyle National Type FS or FSC for shallow devices and Type FD or FDC for deep devices. Boxes for ceiling mounted light fixtures shall have approved no-bolt fixture studs. Boxes used as junction boxes shall have beveled edge flat steel blank cover.
- K. Where outlet boxes are mounted exposed in unfinished areas, (where approved by the engineer) surface mounted boxes shall be 4" square, have rounded corners and 1/2" raised steel cover plates.
- L. Location of outlets on small drawings is approximate and exact dimensions for locations of outlets shall be as taken from large scale plans and details on drawings or as directed by the architect/engineer. Outlets shall be located generally from column centers and finished wall lines or to center of wall or joints between wall

panels. Ceiling outlets shall be installed at elevation of suspended ceiling connected to outlets in ceiling or slab above. Where necessary to fit and center with panel or ceilings and wall spaces, the contractor must at his own expense shift the lighting outlets or other outlets as required by the architect.

- M. Boxes for switches at or near door shall be installed on the side opposite the hinge. Verify door swing direction prior to rough-in.
- N. To prevent sound from traveling through walls, electrical devices from different rooms shall not be mounted in the same stud place. Through-wall boxes shall not be used. In fire rated walls or partitions, outlet boxes on opposite sides of walls or partitions shall be separated by a horizontal distance of 24 inches. Outlet boxes larger than 4" square shall not be installed in fire rated walls or partitions. Verify location of fire rated walls or partitions with Architectural drawings prior to rough-in.
- O. Mark all junction boxes and pull boxes with type and service in permanent, engraved label.

3.11 TELEPHONE, CABLE TV, COMMUNICATIONS, AND OTHER SYSTEMS CONDUIT

- A. These specifications include the furnishing of all labor, and materials necessary for the complete installation of a system of conduits, outlets, and boards for use by the system suppliers.
- B. This installation must be done according to the requirements of the system suppliers and the general specifications covering "Light and Power" herewith.
- C. Provide and install pull boxes at all locations as required by the system suppliers.
- D. Provide and install conduit sleeves thru floors and walls as required by the system suppliers.
- E. The systems shall be provided with main service conduit sized as indicated on drawings. Each phone, data or TV location requires 3/4" empty conduit with pull rope unless noted otherwise. Conduits shall be routed to nearest associated telephone or data terminal board. Verify conditions of job prior to rough-in.
- F. Outlets:
 - 1. All wall outlets shall be installed with standard square box, plates furnished by system suppliers, or as directed. All outlets to be located as directed. Outlet boxes not used shall be provided with blank covers.

- G. Provide 8' X 4' X 3/4" fire retardant plywood backboard for each telephone/data terminal board. Paint to match wall.
- H. Install the raceway system as shown on drawings.
- I. All conduit ends shall be equipped with non-metallic insulated bushings.
- J. All 2, 3 & 4 inch conduits within buildings shall include pull boxes after every two 90 degree bends. Size per NEC Article 370.
- K. Vertical conduits/sleeves through closets floors shall terminate not less than 3 inches above the floor and not less than 3 inches below the ceiling of the floor below.
- L. Terminate conduit runs to/from the associated telephone or data backboard in a closet or designated space at the top or bottom of the backboard. Conduits shall enter closets next to the wall and be flush with the backboard.
- M. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.
- N. All empty conduits located in equipment closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- O. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards.
- P. Furnish and install nylon pull rope in all empty conduits. (Sleeves through floor/wall are exceptions).

END OF SECTION 16110

SECTION 16120 - WIRES AND CABLES, LOW VOLTAGE (600 VOLTS AND BELOW)

PART 1- GENERAL

1.1 DESCRIPTION:

- A. This section includes the furnishing, installation, and connection of the power, lighting, system, and control wiring.

PART 2 - PRODUCTS

2.1 CABLE AND WIRE (POWER AND LIGHTING):

- A. Cable and Wire: Fed. Spec. J-C-30, except as hereinafter specified. All conductors shown on plans are sized for copper. UL label required.

All cable and wiring shall be continuous between electrical equipment. Splices shall not be added except as required for taps in branch circuits or as approved by the engineer. No splices will be allowed with-in panelboards and switchboards.

- B. Single Conductor:

1. Soft annealed copper.
2. Stranded for sizes No. 8 and larger. Solid for sizes No. 10 and smaller.
3. Minimum size No. 12, except where larger sizes are shown. (Size #14 minimum for controls).

- C. Insulation:

1. THHN-THWN, XHHW - Sizes 12, 10, and 8. THHN-THWN, THW, XHHW -Sizes 6 and larger.

- D. Install a ground wire sized per NEC 250-95 in each conduit containing phase conductors.

- E. Color Code:

1. All conductors shall be identified by circuit number and color coding at all termination points and splices. All conductors shall be identified in all pull and junction boxes by the following method of color coding. Means of identification shall be permanently posted at each branch circuit panel with a nameplate identifying color coding system used in that panelboard.

Phase	208/120 V	480/277 V
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	Gray*
Ground	Green	Green
Iso. Grd	Green w/Yellow	Green w/Yellow

* or white with colored (other than green) tracer.

2. Use solid color compound or solid color coating for No. 6 and smaller branch circuit conductors and neutral sizes.
3. Phase conductors No. 4 and larger color code using one of the following:
 - a. Solid color compound or solid color coating.
 - b. Colored as specified using 3/4-inch wide tape. Apply tape in half overlapping turns for a minimum of three inches for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
 - c. Yellow stripe on Iso. Grd. may be 1/4" wide yellow tape on top of green.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Provide plastic engraved color code legend on each panel board and switch board per NEC 210-4 (d).
6. All improperly color coded conductors will be completely replaced at no additional cost to Government.

2.2 SPLICES AND JOINTS:

- A. In accordance with UL 486 A, B, D and NEC.
- B. Branch circuits (No 10 and smaller):
 - 1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C. with integral insulation, approved for copper and aluminum conductors.
 - 2. The integral insulator shall have a skirt to completely cover the stripped wires.
 - 3. The number, size, and combination of conductors, as listed on the manufacturer's packaging shall be strictly complied with.
- C. Feeder Circuits:
 - 1. All feeder conductors shall be the same size and type and be continuous from overcurrent device to panel.
 - 2. Connectors shall be indent type, connectors shall be UL listed for use with the size and type of wire installed of high conductivity and corrosion-resistant material. Do not install more than one conductor per connector unless the connector is UL listed for use with the number of conductors installed.
 - 3. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
 - 4. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulation rating shall be not less than that of the conductor that is being joined.
 - 5. Plastic electrical insulating tape: Flame retardant, cold and weather resistant.

2.3 CONTROL WIRING:

- A. Unless otherwise specified in other sections of these specifications, size control wiring as specified for power and lighting wiring, except the minimum size shall be not less than No. 14, 90°C. insulation. Where stranded conductors are used, provide with spade type insulated copper terminals.
- B. Size wire large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 COMMUNICATION AND SIGNAL WIRING:

- A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.
- B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.
- C. Multi-conductor cables shall have the conductors color coded.

2.5 WIRE LUBRICATING COMPOUND:

- A. The cable pulling lubricant shall be compatible with all cable jackets. The lubricant shall be UL (or CSA) listed. The lubricant shall contain no waxes, greases, silicones, or polyalkylene glycol oils or waxes.
- B. A 200-gram sample of the lubricant, when placed in a one-foot, split metal conduit and fully dried for 24 hours at 105°C, shall not spread a flame more than three inches beyond a point of ignition at a continued heat flux of 40 kW/m². Total time of test shall be one-half hour.
- C. Approved Lubricant is:

Polywater J available from:

American Polywater Corporation

Equal by Quick Slip from Buchanan

CCR Wire Pulling Lube from CRC

Poly-X from American Colloid.

2.6 FIREPROOFING TAPE:

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arcproof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200 ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 7 mils thick, and 3/4-inch wide.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERALLY:

- A. Install in accordance with the NEC, and as specified.
- B. Install all wiring in raceway systems.
- C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes. Do not splice cables in panelboards, switchboards, disconnects, etc.
- D. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- E. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, and tie all cables.
- F. Seal cable and wire entering a building from underground between the wire and conduit, where the cable exits the conduit, with a non-hardening approved compound.
- G. Wire Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - 2. Use ropes made of nonmetallic material for pulling feeders.
 - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the engineer.
 - 4. Pull multiple cables into a single conduit with a single continuous pull.
 - 5. Always use wire lubricant per this specification.

3.2 INSTALLATION IN MANHOLES:

- A. Install and support cables in manholes on the steel racks with porcelain or equal insulators. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.

Fireproofing:

1. Where low voltage cables are installed in the same manholes with high voltage cables, also cover the low voltage cables with arc proof and fireproof tape.
2. Use tape of the same type as used for the high voltage cables, and apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than one inch into each duct.
3. Secure the tape in place by a random wrap of glass cloth tape.

3.3 SPLICE INSTALLATION:

- A. Splices and terminations shall be mechanically and electrically secure.
- B. Where the engineer determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

3.4 CONTROL, COMMUNICATION, AND SIGNAL WIRING INSTALLATION:

- A. Unless otherwise specified in other sections of these specifications, install wiring as described below. Wiring shall be connected to perform the functions shown and specified in other sections of this specification.
- B. Except where otherwise required, install a separate power supply circuit for each system, or control equipment, or control power. Circuit to nearest 120 volt panel or nearest emergency panel if equipment controlled is connected to emergency system. Use spare 20 Amp breakers in panels where none are designated. Verify all requirements with actual equipment supplied in field.
- C. Install a breaker lock-on clip on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- D. System voltages shall not exceed 120 volts and shall be lower voltages where shown on the drawings or required by the NEC.

E. Wire and cable identification:

1. Install a permanent wire marker on each wire at each termination, outlet box, junction box, panel, and device.
2. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
3. Wire markers shall retain their markings after cleaning.
4. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.5 FEEDER IDENTIFICATION:

- A. In each, interior pullbox and junction box, install metal tags on each circuits cables and wires to clearly designate their circuit identification and voltage.
- B. In manholes and handholes, provide tags of the embossed brass type, that show the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

3.6 FIELD TESTING:

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Test shall be performed by meggar and conductors shall test free from short-circuits and grounds.
- C. Test conductors phase-to-phase and phase-to-ground.
- D. Meggar motors after installation but before start-up and test free from grounds.
- E. The contractor shall furnish the instruments, materials, and labor for these tests.

END OF SECTION 16120

SECTION 16124 - CABLES, MEDIUM VOLTAGE (Above 600 Volts)

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes the furnishing, installation and connection of the medium voltage cables.
- A. Samples:
 - 1. When requested by the engineer, furnish a twelve inch length of each type and size of wire and cable along with the tag from the coils or reels from which the samples were taken. The sample shall contain the manufacturers markings.
- B. Standards:
 - 1. The cable shall meet or exceed the latest editions of the following industry specifications:
 - REA Spec U-1 dated 12/87
 - AEIC CS-6 1987 (Assoc. of Edison Illuminating Co.)
 - ICEA S-68-516 (Insulated Cable Engineers Assoc.)
 - ASTM B-231, B-233, and B-609
- C. Certifications:
 - 1. Factory test reports:
 - a. Prior to installation of the cables, deliver four copies of the manufacturers certified IPCEA standard factory test reports for representative cables to the engineer.
 - b. Certified test reports shall include the following:
 - 1) AC and DC voltage withstand test results per AEIC CS-6.
 - 2) Partial discharge (or corona) test results showing no discharge higher than 5 picocoulombs at three times the operating voltage of the cable. If any reel chart shows discharge higher than 5 pc, reel shall be rejected.

2. Field test reports: After testing, submit four certified copies of each of the graphs, specified under field testing, to the engineer. Adequate information shall be included identifying the cable locations, types, voltage rating and sizes.
3. Splices and terminations:
 - a. After the splices and terminations have been installed and tested, deliver four copies of a certificate by the contractor to the engineer which includes the following:
 - 1) A statement that the materials, detailed drawings and printed instructions used were those contained in the kits approved for this contract.
 - 2) A statement that each splice and each termination was completely installed without any overnight interruption.
 - 3) A statement that field made splices and terminations conform to the following requirements:
 - a) Pencil the cable insulation precisely.
 - b) Connector installations:
 - (1) Use tools which are designed for the connectors being installed.
 - (2) Round and smooth the installed connectors to minimize localized voltage stressing of the insulating materials.
 - c) Remove contaminants from all surfaces within the splices and terminations before installing the insulating materials.
 - d) Solder block throughout stranded grounding wires which will penetrate the splicing and terminating materials.
 - e) Use mirrors to observe the installation of materials on the back sides of the splices and terminations.

- f) Eliminate air voids throughout the splices and terminations.
 - g) Stretch each layer of tape properly during installation.
 - 4) List all of the materials purchased and installed for the splices and terminations for this contract including the material descriptions, manufacturer's names, catalog numbers and total quantities.
 - C. Installer Approval:
 - 1. Employees who install the splices and terminations shall have not less than three years of experience splicing and terminating cables which are equal to those being spliced and terminated, including experience with the materials in the kits. Furnish satisfactory proof of such experience for each employee who splices or terminates the cables.
 - D. Warranty:
 - 1. The manufacturer shall provide a written warranty guaranteeing the cable for 40 years against dielectric failure or poor workmanship.

PART 2 - PRODUCTS

2.1 MATERIAL, MEDIUM VOLTAGE CABLE:

- A. Medium voltage cable shall be in accordance with the NEC, IPCEA and UL. Manufacturers shall be: Southwire, Kerite or Okonite.
- B. Conductor:
 - 1. Shall be single conductor stranded copper.
 - 2. Cable shall be shielded.
 - 3. Cable shall be rated for 15kV.
- C. Conductor Screen:
 - 1. Extruded semi-conducting ethylene propylene rubber (EPR), meeting or exceeding the requirements of ICEA S-68-516, and AEIC CS-6. The conductor screen shall be free of any voids, contaminants, or protrusions and shall be firmly bonded to the insulation yet free stripping from the conductor.

- D. Insulation:
1. Insulation level shall be 133%, extruded ethylene propylene rubber (EPR) meeting or exceeding the requirements of ICEA S-68-516 and AEIC CS-6. The EPR shall not contain any polyethylene in the compound formula. The EPR insulation must have a field experience record of over 15 years.
- E. Insulation Screen:
1. Extruded semi-conducting ethylene propylene rubber (EPR) meeting or exceeding the requirements of AEIC CS-6 and ICEA S-68-516. The semi-conducting screen must have a strip tension between 6 and 24 lbs. per square inch consistently throughout each length of cable.
 2. The conductor screen, insulation, and insulation screen shall be applied via the triple tandem extrusion method to avoid any voids and contaminants between insulation and semiconductor.
- F. Jacket:
1. Black linear low density polyethylene, meeting or exceeding AEIC CS-6 and ICEA S-68-516. The jacket shall be extruded directly over and encapsulate the neutral wires. The minimum average thickness of the jacket shall be .050", and the minimum thickness at any point shall be .040". Thickness for 750 MCM shall be .080" minimum average and not less than .065" at any point.
- G. Cable temperature ratings for continuous operation, emergency overload operation and short circuit operation shall be not less than the IPCEA Standard for the respective cable.
- H. Manufacturer's name and other pertinent information shall be marked or molded clearly on the overall outside surface of the jackets, or incorporated on marker tapes within the cables at reasonable intervals.

2.2 MATERIAL, SPLICES AND TERMINATIONS:

- A. The materials shall be compatible with the conductors, insulation's and protective jackets on the cables and wires.
- B. The splices shall insulate and protect the conductors not less than the insulation and protective jackets on the cables and wires which protect the conductors. In locations where moisture might be present, the splices shall be watertight. In manholes and handholes the splices shall be submersible.

C. Splicing and Terminating Fittings:

1. Shall be heavy duty, pressure type fittings, which will assure satisfactory performance of the connections under conditions of temperature cycling and magnetic forces from available short circuit currents.
2. The fittings shall be suitable designed and the proper size for the cables and wires being spliced and terminated. Terminations to bus shall be with two hole lugs.
3. Where the engineer determines that unsatisfactory fittings have been installed, remove the unsatisfactory installations and install approved fittings at no additional cost to the Government.

D. Splicing and Terminating Kits:

1. General;

- a. Shall be assembled by the manufacturer or supplier of the materials and shall be packaged for individual splices and terminations or for groups of splices and terminations.
- b. Shall consist of materials designed for the cables being spliced and terminated and shall be suitable for the prevailing environmental conditions.
- c. Shall include detailed drawings and printed instructions for each type of splice and termination being installed, as prepared by the manufacturers of the materials in the kits.
- d. Detail drawings, and printed instructions shall indicate the cable type, voltage rating, manufacturer's name and catalog numbers for the materials indicated.
- e. Voltage ratings for the splices and terminations shall be not less than the voltage ratings for the cables on which they are being installed.
- f. Shall include shielding and stress cone materials.

2. Taped splices and terminations:

- a. Insulating and semi-conducting rubber tapes shall withstand 200 percent elongation without cracking, rupturing or reducing their electrical and self-bonding characteristics by more than 5 percent.

3. Epoxy resin kits shall be as follows:
 - a. Compatible with the cable insulation's and jackets and make the splices watertight and submersible.*
 - b. Thermosetting and generate its own heat so that external fire or heat will not be required.
 - c. Set solid and cure in approximately 60 minutes in 70 degree F ambient temperature.
 - d. Not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.
 - e. Furnished in pre-measured quantities, sized for each splice and each termination, with two resin components in an easy mixing plastic bag which will permit mixing the resin without entrapping air or contaminants. Other methods of packaging and mixing the epoxy resin components will be considered for approval, provided they include adequate safeguards to assure precise proportioning of the resin components and to prevent entrapping air and contaminants.
 - f. Use snap-together, longitudinally-split, interlocking seam, transplant mold bodies or taped frameworks, injection fittings and injection gun or pouring equipment. Completely fill voids within the splices and terminations.

E. Premolded Rubber Splices and Terminations:

1. Splices and terminations shall be in accordance with IEEE 48, 386, 404 and 592.
2. Premolded rubber devices shall have a minimum of 0.125 inch semi-conductive shield material covering the entire housing. Test each rubber part prior to shipment from the factory.
3. Grounding of metallic shields shall be accomplished by a solderless connector enclosed in a watertight rubber housing covering the entire assembly. The grounding device and splice or terminator shall be of same manufacturer to insure electrical integrity of the shielded parts.
4. The premolded parts shall be suitable for indoor, outdoor, submersible, or direct-burial applications.

2.3 MATERIAL, FIREPROOFING TAPE:

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arcproof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus. It shall be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 1000 ampere arc for not less than 30 seconds.
- E. Securing tape: Shall be glass cloth electrical tape not less than 7 mils thick, and 3/4-inch wide.

2.4 CABLE FAULT INDICATORS:

- A. Provide/install cable fault indicators, flag type as manufactured by S & C or approved equal on all terminations.

2.5 CABLE PULLING LUBRICANT:

- A. The cable pulling lubricant shall be compatible with all cable jackets. The lubricant shall be UL (or CSA) listed. The lubricant shall contain no waxes, greases, silicones, or polyalkylene glycol oils or waxes.
- B. A 200-gram sample of the lubricant, when placed in a one-foot, split metal conduit and fully dried for 24 hours at 105°C, shall not spread a flame more than three inches beyond a point of ignition at a continued heat flux of 40 kW/m². Total time of test shall be one-half hour.
- C. Approved Lubricant is:

Polywater J available from:

American Polywater Corporation

Equal by Quick Slip from Buchanan

CCR Wire Pulling Lube from CRC

Poly-X from American Colloid.

PART 3 - EXECUTION

3.1 INSTALLATION, MEDIUM VOLTAGE CABLE:

- A. Installation shall be in accordance with the NEC, and as shown on the drawings.
- B. Use the specified lubricating compounds on the cables and wires to prevent damage to them during pulling-in. Provide compounds that are not injurious to the cable and wire jackets.
- C. Splice the cables and wires only in manholes and accessible junction boxes.
- D. In manholes, trenches and vaults:
 - 1. Install the cables on suitable porcelain insulators with steel cables racks.
- E. In manholes, underground raceways and other outdoor locations:
 - 1. Seal the cable ends prior to pulling them in to prevent the entry of moisture.
 - 2. For ethylene propylene rubber and polyethylene insulated cables, use bags of epoxy resin which are not less than 1/4-inch larger in diameter than the overall diameter of the cable. Clean each end of each cable before installing the epoxy resin over it.

3.2 INSTALLATION, SPLICES AND TERMINATIONS:

- A. Install the materials as recommended by their manufacturer including special precautions pertaining to air temperature during installation.
- B. Ethylene Propylene Rubber and Polyethylene Insulated Cables:
 - 1. Cables rated 8000 volts or less: Install epoxy resin splices and terminations, or premolded rubber splices and terminations.
 - 2. Cables rated more than 8000 volts: Install taped splices and terminations, or premolded rubber splices and terminations.
- C. Installation shall be accomplished by qualified personnel trained to accomplish medium voltage equipment installations. All instructions of the manufacturer shall be followed in detail.

3.3 INSTALLATION, FIREPROOFING:

- A. Cover all power cables located in manholes, handholes, and junction boxes with arcproof and fireproof tape.
- B. Apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than one inch into each duct.
- C. Secure the tape in place by a random wrap of glass cloth tape.

3.4 FEEDER IDENTIFICATION:

- A. In each manhole and pullbox install permanent tags on each circuit's cables and wires to clearly designate their circuit identification and voltage. In manholes the tags shall be the embossed brass type and shall also show the cable type and voltage rating. Position the tags so they will be easy to read after the fireproofing is installed.

3.5 FIELD TESTS FOR MEDIUM VOLTAGE CABLE:

- A. New Cable:
 - 1. Acceptance tests shall be performed on new cable.
 - 2. Test new cable after installation, splices, and terminations have been made, but before connection to equipment and existing cable.
- B. High Potential Test:
 - 1. Leakage current test shall be by high potential dc step voltage method.
 - 2. Prior to high potential test, test the cable and shields for continuity, shorts, and grounds.
 - 3. High potential test shall measure the leakage current from each conductor to the insulation shield. Use corona shields, guard rings, taping, mason jars, or plastic bags to prevent corona current from influencing the readings. Unprepared cable shield ends shall be trimmed back one inch or more for each 10kV of test voltage.

C. Safety Precautions:

1. Exercise suitable and adequate safety measures prior to, during, and after the high potential tests, including placing warning signs and preventing people and equipment from being exposed to the test voltages.

D. Test Voltages:

1. New shielded EPR cable dc test voltages shall be as follows:

Rated Circuit Voltage Phase-to-Phase Volts	Wire Size AWG or MCM	Test Voltage kV	
		100 percent Insulation Level	133 percent Insulation Level
2001-5000	8-1000	25	25
5001-8000	6-1000	35	35
8001-15000	2-1000	55	65
15001-25000	1-1000	80	100
25001-28000	1-1000	85	
28001-35000	1/0-1000	100	

E. High Potential Test Method:

1. Apply voltage in approximately 8 to 10 equal steps.
2. Raise the voltage slowly between steps.
3. At the end of each step, allow the charging currents to decay, and time the interval of decay.
4. Read the leakage current and plot a curve of leakage current versus test voltage on graph paper as the test progresses. Read the leakage current at the same time interval for each voltage step.
5. Stop the test if leakage currents increase excessively or a "knee" appears in the curve before maximum test voltage is reached.
 - a. For new cable, repair or replace the cable and repeat the test.
 - b. For existing cable interconnected to new cable, notify the engineer for further instructions.

6. Upon reaching maximum test voltage, hold the voltage for five minutes. Read the leakage current at 30 second intervals and plot a curve of leakage current versus time on the same graph paper as the step voltage curve.
 - a. Stop the test if leakage current starts to rise, or decreases and again starts to rise. Leakage current should decrease and stabilize for good cable.
7. Terminate test and allow sufficient discharge time before testing the next conductor.

END OF SECTION 16124

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section includes the furnishing, installation, and connection of wiring devices.

PART 2 - PRODUCTS

2.1 RECEPTACLES:

A. LIST OF ACCEPTABLE RECEPTACLE MANUFACTURERS

Manufacturer:	P&S	Hubbell	Eagle	Leviton	G.E.	Bryant
1. Specification Grade: Duplex Receptacle (20 A. 125V.)	5362	5362	5362	5362	GE 5362	5362
2. Ground Fault Circuit Interrupter Duplex Receptacle (20A, 125 V.)	2091S	GF 5352	647	6898-HG	GF 5342	GFR53F
3. Isolated Ground Duplex Receptacle (20A, 125 V.)	IG6300	IG5362	IG5362	5362-IG	GF 5362-IG	5362IG SP53TIG SP52TIG

- B. Weatherproof duplex receptacles shall be GFCI grounded twin outlet receptacle rated 20 ampere at 125 volts. This receptacle shall be equipped with a single weatherproof, coverplate. Where receptacles are to be in use for specific equipment, provide raintight while in use, NEMA 3R, safety outlet enclosure, with lift cover equal to Taymac #60310 or #20110 or equal by Carlon.
- C. See plans for special outlet schedule.
- D. Receptacle body shall be formed of high-impact nylon faced thermoplastic or urea and receptacle contacts shall be Bronze.
- E. When only one receptacle is connected to a 20 amp circuit by itself, that receptacle must be rated 20 Amp.
- F. All receptacles shall be self grounding with ground lug.
- G. Install receptacles to clear all cabinets, equipment, etc.
- H. Color of receptacles to be verified with Architect prior to ordering.

- I. All 120V, 15 or 20A receptacles located, within 6 ft. of a sink, exterior locations, elevator machine rooms, elevator pits, garages, per NEC and as located on the plans shall be ground fault protected. Feed through GFCI receptacles or GFI breakers may be used to protect other receptacles in the same room and on the same circuit if wired per the manufacturer's recommendations. Prior to final inspection, perform ground fault test on each protected receptacle and submit list of all receptacles tested with results to the engineer. Label receptacles that are GFCI protected by another feed through GFCI receptacle or by GFI breaker "GFI protected".
- J. Provide duplex receptacle on separate circuit beside each telephone terminal board location and other communications equipment requiring 120V, power.

2.2 TOGGLE SWITCHES:

- A. Wall Switches: Wall switches in general, used to control lighting, shall be quiet operating, listed by U.L. and conform to NEMA standards as well as the latest Federal Specification W-S-896e.
- B. Switches shall be single pole, two-pole, three-way, four-way, keyed, and with pilot light as called for on the drawings. Groups of switches shall be under one gangplate. Where switches are in fire rated walls groups of switches shall be maximum of 2 gangs under one cover plate.
- C. Switches shall be as follows unless specified otherwise.

Single Pole	20 A. 125 V. 277 V.
Two Pole	20 A. 125 V. 277 V.
Three-Way	20 A. 125 V. 277 V.
Four-Way	20 A. 125 V. 277 V.
Pilot Light	20 A. 125 V. 277 V.

- D. When only one switch is connected to a 20 amp circuit by itself, it must be rated 20A.
- E. All switches shall be self grounding w/ground lugs.
- F. LIST OF ACCEPTABLE SWITCH MANUFACTURERS

Manufacturer:	P&S	Hubbell	Eagle	Leviton	G.E.	Bryant
Specification Grade Switches	20AC1 Series	1220 Series	2220 Series	1220 Series	5950 Series	4901
Pilot Light Switches	20AC1-CPL Series	1220-PL Series	2220-PL Series	1221-PLR Series	SP120-8G Series	4801PLR12

- G. Pilot light switches shall be illuminated toggle switch lighted red in "on" position.
- H. Color of switches to be verified with Architect prior to ordering.

- I. Provide barriers between 277V. switches and between 277V. and 120V. switches installed in a common outlet box.

2.3 WALL PLATES:

- A. Wall plates shall be flexible (non breakable) nylon or polycarbonate.
- B. Color shall be verified with Architect prior to ordering and shall match devices.
- C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- D. Provide plates for all telephone, cable TV, communication outlets. Provide blank coverplate for outlets not used.

2.4 FUSTATS:

- A. Fustats shall be Bussmann "SSY" with fustat and integral toggle switch for motors 1/2 HP 120V. and less. Fustats for 3/4 HP 120V. motors shall be Bussmann "SOY" with fustat and separately mounted 20A. 1P. 120V. toggle switch adjacent to fustat. Mount fustats in housings of equipment served. Fuses for motors shall be sized based on 125% of manufacturer's nameplate full load amperage unless otherwise indicated on drawings. Plug fuses shall be time delay dual element Bussmann Type 'S'.

2.5 MOTION SENSORS

A. General:

1. Shall be the product of a manufacturer with 5 years experience in the manufacture of infrared/ultrasonic motion sensing products for the control of lighting.
2. Shall have an adjustable time delay of 0-15 minutes.
3. Shall have an adjustable sensitivity setting.
4. Shall have a five year warranty.

B. Products:

1. Wall mounted (300SF.)

SECTION 16321 - TRANSFORMERS, PADMOUNTED

PART 1 - GENERAL

- 1.1 This section includes the furnishing, installation, and connection of padmounted transformers. Transformers shall be complete, continuous duty, integral assembly, grounded, tamper-resistant, weatherproof, outdoor type with liquid-immersed transformers.
- 1.2 APPROVED MANUFACTURERS:

Square 'D
Westinghouse
General Electric
ITE.

PART 2 - PRODUCTS

- 2.1 EQUIPMENT, GENERAL:
- A. Equipment shall be in accordance with ANSI, IEEE, NEMA, NEC, as shown on the drawings, and as hereinafter specified.
 - B. KVA and voltage ratings shall not be less than shown on the drawings.
 - C. Provide units designed to withstand the mechanical stresses caused by rough handling during shipment in addition to the electrical and mechanical stresses which occur during operation.
 - D. Completely fabricate units at the factory so that only the external cable connections are required at the job site.
 - E. Thoroughly clean, phosphatize and finish all the metal surfaces at the factory with a rust-resistant primer and dark green enamel finish coat, except where a different color is specified in the Section covering Painting. All surfaces of the unit to be in contact with the concrete pad shall be treated with corrosion-resistant compounds and epoxy resin, or a rubberized sealing compound.

2.2 COMPARTMENTS:

A. Construction:

1. The medium and low voltage compartments, the transformer compartment and the transformer tank shall be assembled as an integral unit by a single manufacturer.
2. Separate the medium and low voltage compartments with a steel barrier.
3. Construct the compartments of sheet steel of sufficient gage to meet ANSI requirements, with bracing, reinforcing gussetts and jig-welding to assure rectangular rigidity.
4. Use cadmium or zinc plated bolts, nuts, and washers.
5. Provide sufficient space for equipment, cabling, and Terminations in the compartments.
6. Permanently affix the transformer instruction nameplate to the unit within the low voltage compartment. Voltage ratings, KVA, connection configuration, impedance, and serial number shall be shown on the nameplate.

B. Doors:

1. Provide a separate door for each compartment with provision for a single padlock to secure the compartment area. The medium voltage compartment door shall be prevented mechanically from opening, unless the low voltage door is opened.
2. The secondary compartment door shall have a one piece steel handle and incorporate three-point locking mechanisms to assure a secure and tight door closing. Provide each compartment door with open-position door stops and tamperproof hinges. The hinge assembly shall be made of corrosion-resistant material welded in place.
3. Provide a 2-inch size padlock for each assembly. Padlocks shall be keyed to the Governments established key set. Firmly attach the padlock to the door assembly by a chain.

2.3 VOLTAGE AND BIL RATING:

- A. 15 kV class equipment shall have a minimum 95 kV BIL rating.

2.4 DEAD FRONT CONSTRUCTION:

- A. All transformers shall be deadfront. No exposed live parts, including the cable Terminations, shall be accessible within the medium voltage compartment.
- B. Make connection to the medium voltage switch through 200 ampere externally clamped universal bushing wells mounted within the transformer tank and bushing inserts. Provide a parking stand for each cable that terminates within the medium voltage compartment.

2.5 TRANSFORMERS FUSE ASSEMBLY:

- A. The fuses shall be concealed, hot stick removable, Bay-O-Net, load break, oil immersed expulsion type-externally accessible fault sensing w/isolation links. Transformers 750 KVA and smaller shall have current limiting elements, non-expulsion and non-isolation links. The fuses shall operate within the fuse holder as a unit disconnecting means.
- B. Transformers shall not have internal 'weak link' fuses requiring transformer tank cover removal for replacement.

2.6 PRIMARY SWITCHES:

- A. The transformer primary disconnect switch for radial feeds shall be an oil-immersed, internal, gang-operated, load-interrupter type, rated 200 amperes, with a close-in on fault duty of 5,000 amperes symmetrical. The switch is to be a two-position, on-off, manual switch located in the medium voltage compartment and hot stick operated.

2.7 MEDIUM VOLTAGE PREFORMED TERMINATIONS:

- A. Terminate the medium voltage cables in the medium voltage compartment with load break premolded rubber elbow connectors. Elbow connectors shall have a minimum of 0.125 inch semi-conductive shield material covering the housing. Test each rubber part prior to shipment from the factory. See Section 16124 for live front Terminations.
- B. Ground metallic cable shields with a device designed for the purpose. It shall consist of a solderless connector enclosed in watertight rubber housing covering the entire assembly. The grounding device and elbow connector are to be the same manufacturer to insure electrical integrity of shielded parts.

- C. Premolded parts shall be suitable for submersible applications.
- D. Elbow connectors shall be rated as follows:
 - 1. BIL: 95 kV.
 - 2. AC withstand: 34 kV, 60 Hz for 1 minute.
 - 3. DC withstand: 65 kV(field testing rating).
 - 4. Corona voltage: 11 kVminimum.
 - 5. Continuous current: 200 amperes RMS.
 - 6. Short time current: 10,000 amperes for 12 cycles.
 - 7. Fault closure: 10,000 amperes RMS symmetrical for 10 cycles.
 - 8. Switching: (Load Break) 10 loadmake/loadbreak operations at 200 amperes, 70-80 percent power factor, maximum recovery voltage between contacts.
- E. Interchangeability: The separable connector system shall include the elbow, the bushing insert, and bushing well. Separable connectors shall comply with the requirements of ANSI C119.2, and shall be interchangeable between suppliers. Provide the elbow and the bushing insert from the same manufacturer.
- F. Allow sufficient slack in medium voltage cable, ground, and drain wires to permit elbow connectors to be moved to their respective parking stands.
- G. Provide insulated cable supports to relieve any strain imposed by cable weight or movement.

2.8 LOW VOLTAGE EQUIPMENT:

- A. House the low voltage bushings in the low voltage compartment. The low voltage leads shall be brought out of the tank by epoxy, pressure tight bushings, and shall be standard arrangement per ANSI.
- B. Tin plate the low voltage neutral terminal and insulate from the transformer tank. Provide a removable ground strap sized in accordance with the NEC and connect between the neutral and ground pad.
- C. The number of holes in the secondary bushing spades shall be equal to or greater than the number of sets of secondary conductors. Verify quantity with the drawings. Provide all lugs of size and ratings to match the secondary feeder.

2.9 TRANSFORMERS:

- A. Transformers shall be three-phase liquid-immersed, isolated winding, and self cooled by natural connection.
- B. The KVA ratings shown on the drawings are for continuous duty without the use of cooling fans.
- C. Temperature rises shall not exceed the NEMA Standards of 65 degrees C by resistance, and 80 degrees C hot spot rated KVA.
- D. Transformer insulating mineral oil shall be in accordance with ASTM.
- E. Impedance shall not be less than 4.5 percent for sizes 150 KVA and larger.
- F. Sound levels shall conform to NEMA Standards.
- G. Primary and Secondary Windings for Three-phase Transformers:
 - 1. Primary windings shall be delta connected unless otherwise indicated on the drawings.
 - 2. Secondary windings shall be wye-connected, except where otherwise indicated on the drawings. Provide isolated neutral bushings for secondary wye-connected transformers.
- H. Provide four 2-1/2 percent full capacity voltage taps in the primary winding; two taps above and two below rated voltage.
- I. Core and Coil Assemblies:
 - 1. Cores shall be rigidly braced, grain-oriented, non-aging silicon steel to minimize losses.
 - 2. Brace the core and coil assembly to withstand the stresses caused by rough handling during shipment, and stresses caused by short circuit currents.
 - 3. Primary, secondary and tap connections shall be braced or pressure type.
 - 4. Provide end fillers or tie downs for coil windings.
- J. The transformer tank, cover, and radiator gage thickness shall not be less than that outlined in ANSI.

K. Accessories:

1. Provide standard NEMA features, accessories, and the following:
 - a. No-load tap changer (Provide warning sign).
 - b. Lifting and jacking facilities.
 - c. Globe-type valve for filtering and oil draining, including sampling device.
 - d. Pressure relief valve.
 - e. Liquid level gage and filling plug.
 - f. A grounding pad in the medium and low voltage compartments.
 - g. A diagrammatic nameplate and operating instructions enclosed by a transparent cover located in the low voltage compartment.
 - h. Dial type thermometer.
 - i. Hot stick. Securely fastened within low voltage compartment.
2. The accessories shall be made accessible within the compartments without disassembling trims and covers.

2.10 PRIMARY LIGHTNING ARRESTERS:

- A. Provide distribution class lightning arresters located in the medium voltage compartment. Ratings shall be 9 kV as required for the specified primary voltage.
- B. Arresters shall be dead front type mounted on elbows to matching the medium voltage bushings. Provide additional bushings as required for proper connections.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install the equipment in accordance with the NEC, as shown on the drawings, and as recommended by the equipment manufacturer.
- B. Foundations:

1. Provide foundations pads of reinforced concrete, Type C (3000 psi minimum, 28 day compressive strength).
2. Locate the top of foundation pads six inches above the adjacent finished grade, unless otherwise shown on the drawings. Refer to details for size, location and structural steel reinforcing required.
3. Grade the adjacent terrain so that surface water will flow away from the foundation.
4. Anchor the unit with bolts not less than 1/2-inch diameter.

C. Grounding:

1. Ground each padmounted transformer in accordance with the requirements of the NEC. Three-quarter inch diameter by 10 feet long copper-clad ground rods, driven 10 feet below grade, shall be used to maintain a maximum resistance of five ohms to ground. Exothermically weld the cable to the ground rods.
2. Connect the ground rod to the ground pads in the medium and low voltage compartments, and to the secondary (and primary) neutral with not less than a 1/0 AWG bare copper conductor.
3. Independently connect cable shield and arrester grounding devices ground wires to ground with sufficient slack to permit elbow connector operation. Connect arrester grounding leads with ground wire sized by manufacturer. Connect elbow connectors with a No. 14 AWG bare copper drain wire from its grounding eye to the released cable shield grounding device ground wire. Do not connect drain wires in any manner which will permit circulating currents, cable fault currents, to pass through them.

3.2 SPARE PARTS:

- A. Deliver the following spare parts for the project to the Government two weeks prior to final inspection:
1. Six stand-off insulators.
 2. Six insulated protective caps.
 3. One spare set of medium voltage fuses for each size used in the project.

3.3 TESTING:

- A. Provide routine factory tests per ANSI as well as ANSI full wave impulse test observed by oscilloscope. Submit test results to the engineer.

END OF SECTION 16321

SECTION 16400 - DISCONNECT SWITCHES (MOTORS AND CIRCUIT)

PART 1 - GENERAL:

1.1 DESCRIPTION:

- A. This section includes all low voltage disconnect switches either stand alone in NEMA enclosures, fusible and non-fused, in panelboards, switchboards, or switchgear.

1.2 APPROVED MANUFACTURERS:

Square 'D'
General Electric
Siemens/ITE
Westinghouse
Cutler Hammer
Allen Bradley
Pringle.

PART 2 - PRODUCTS:

2.1 LOW VOLTAGE FUSIBLE SWITCHES RATED 800 AMPERES AND LESS:

- A. Quick-make, quick-break type in accordance with UL 98, NEMA KS 1 and NEC.
- B. Shall be capable of accepting UL and NEMA standard fuses.
- C. Shall have the following features:
 - 1. Switch mechanism shall be the quick-make, quick-break type.
 - 2. Copper blades, visible in the OFF position.
 - 3. An arc chute for each pole.
 - 4. External operating handle shall indicate ON and OFF position and shall have lock-open padlocking provisions.
 - 5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable by a special tool to permit inspection.

6. Fuse mounting for the size and type of fuses specified. Furnish switches completely fused. Furnish a complete set of spare fuses for each size and type of fuse being installed.
 7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
 8. Enclosures:
 - a. Shall be NEMA 1 for interior, NEMA 3R for exterior and other types shown on the drawings for the switches.
 - b. Where the types of switch enclosures are not shown, they shall be the NEMA types which are most suitable for the environmental conditions where the switches are being installed.
 9. All fuse holders shall have rejection features to reject all fuses not specified.
- D. Unless indicated otherwise, switches shall be heavy duty and horsepower rated for the load served.

2.2 LOW VOLTAGE UNFUSED SWITCHES RATED 800 AMPERES AND LESS:

- A. Shall be the same of Low Voltage Fusible Switches rated 800 amperes and less, except it shall not accept fuses.

2.3 TOGGLE TYPE SWITCHES:

- A. Provide/install toggle type switches, voltage and horsepower rated for the load served 20 or 30 Amp for all small mechanical equipment as indicated.

2.4 FUSES:

- A. This paragraph applies to all fuses provided under Division 16.
 1. Cartridge type fuses of proper size and type as required shall be furnished and installed for all switches and panelboards throughout and an additional supply of three spare fuses of each size and type shall be furnished in original packages to the Government. Furnish NEMA 1 enclosure with hinged cover equal to Bussmann Type SFC or Edison ESFC, for storing all spare fuses located adjacent to main service equipment. Fuses for motor and mechanical equipment shall be sized per nameplate data and N.E.C.. All fuses shall be of the Class "L" or "J" time delay and rejection type.

2. Fuses shall be manufactured by Bussmann Mfg. Co., Edison, Littelfuse, or Gould-Shawmut. Fuse types shall be installed as follows:

Main Service and Distribution Feeder Protection:

	Bussmann	Gould Shawmut	Littelfuse	Edison
601 amps and larger 600 volts and less (Class L)	KRP-C	A4BQ	KLPC	LCL
600 amps and less 600 volts and less (Class J)	LPJ	AJT	JTD	JDL

3. Class 'R' fuses will not be accepted.
4. All motors shall be protected by Type 'J' fuses as specified above. Fuse manufacturer must list in shop drawings specifically which fuse to install for each motor and starter required to provide Type '2' no damage protection. The contractor must provide and install the selected fuse and switch.
5. Fuses installed on project shall be by one manufacturer only. (Do not intermix manufacturers.)

2.5 FUSTATS:

1. Fustats shall be Bussmann "SSY" or Edison ESSY, with fustat and integral toggle switch for motors 1/2 HP 120V. and less. Fustats for 3/4 HP 120V. motors shall be Bussmann "SOY" or Edison ESOY, with fustat and separately mounted 20A. 1P. 120V. horsepower rated toggle switch adjacent to fustat. Mount fustats in housings of equipment served. Fuses for motors shall be sized based on 125% of manufacturer's nameplate full load amperage unless otherwise indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC and as shown on the drawings.

END OF SECTION 16400

SECTION 16410 - POWER FACTOR CORRECTION

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This Section applies to all motors and capacitors that are specified other sections of this specification and/or Division 16.

- 1.2 All motors furnished for this project 10 HP and larger shall have power factor correction provided and installed to correct the power factor to 95% with the exception of motors controlled by frequency drives.

1.3 APPROVED MANUFACTURERS:

Square 'D'
Sprague
General Electric
Cornell Dublier.

PART 2 - PRODUCTS

2.1 POWER FACTOR CORRECTION CAPACITORS:

- A. Ratings: Voltage, phase, and KVAR shall be as shown on plans or as determined by the equipment supplier to convert the power factor to 95%.
- B. Standards: Capacitor(s) shall be UL listed and designed for installation in accordance with Article 460 of the 1984 National Electrical Code.
- C. Type: Capacitor(s) shall be industrial grade assemblies consisting of individual capacitor cells factory assembled and wired in a heavy duty steel enclosure.
- D. Losses: Typical losses shall not exceed 0.5 W/KVAR.
- E. Capacitor Cells: Capacitor(s) shall be of individual cell construction and utilize polypropylene film as the dielectric. Electrodes shall consist of metallized aluminum layers vacuum deposited to the polypropylene film dielectric. Each capacitor cell shall be furnished with a built-in UL recognized pressure sensitive interrupter and filled with a completely biodegradable fluid. Cells shall be self-healing.
- F. Discharge Resistors: Resistors shall be furnished to reduce the residual voltage to 50 volts or less within one minute after the capacitor has been disconnected from the line.

- G. Enclosure: Enclosures shall be fabricated from sheet steel and be suitable for indoor or outdoor use as required for equipment location. Enclosure shall be designed to contain any fluid that might escape from the capacitor cells. Integral mounting brackets shall be provided for either wall or floor mounting.
- H. Capacitor shall have 20 year rated life.

PART 3 - INSTALLATION

3.1 MOTORS:

- A. Install capacitors per manufacturer recommendations and per N.E.C. at the motor location. Connect to the load side of the starter or between starter and overload. Adjust the size of the starter overloads to match the motor amps with the capacitor. Verify connection requirements with the capacitor manufactured for all reduced voltage starters.
- B. Conductors: All conductors connecting capacitors shall have a minimum ampacity of 135% of the rated current of the capacitor.

END OF SECTION 16410

SECTION 16450 - GROUNDING

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies general grounding and bonding requirements of electrical installations.

PART 2 - PRODUCTS

2.1 GROUNDING WIRES:

- A. General Purpose: UL and NEC approved types, copper, with THW, XHHW or dual rated THHN-THWN insulation color identified green.
- B. Size wire not less than what is shown and not less than required by the NEC.

2.2 GROUND RODS:

- A. Copperclad steel, 3/4-inch diameter by 20 feet long.

2.3 SPLICES:

- A. All splices and grounding electrode connections shall be made with exothermic welds.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERALLY:

- A. Ground in accordance with the NEC as shown, and as hereinafter specified. All equipment ground conductors shall be terminated on a ground bus or ground lug attached to equipment can.
- B. System Grounding:
 - 1. Secondary service neutrals ground at the supply side of the secondary disconnecting means and at the related transformers.

2. Separately derived systems (transformers downstream from the service entrance) ground the secondary neutral.
3. Individual Buildings: Bond Main Disconnect ground bus to building steel, 20' re-bar in foundation, water pipe, driven ground, and ground ring.

C. Equipment Grounding:

1. Metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be grounded for personnel safety and to provide a low impedance path for possible ground fault currents.

3.2 PRIMARY EQUIPMENT AND CIRCUITS:

A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system.

B. Duct Banks and Manholes:

1. Provide a bare equipment grounding conductor in each duct bank containing medium or high voltage cables. Connect the grounding conductors to the switchgear ground bus, to all manhole hardware, to the cable shielding of medium or high voltage cable splices and terminations, and equipment enclosures.
2. Provide a grounding conductor having at least 50 percent ampacity of the largest phase conductor in the duct bank.
3. Connect the equipment grounding conductor to the grounding rod.

C. Pad Mounted Transformers:

1. Provide a driven ground rod and connect with a grounding electrode conductor to the grounding facilities at the transformer.
2. Ground the secondary neutral.
3. Connect lighting arrester grounds to the pad ground per NEC.

- D. Lightning Arresters: Connect lightning arrester grounds to the equipment ground bus, or ground rods as applicable.
- E. Metallic Conduit: Metallic conduits which terminate without mechanical connection to a housing of electrical equipment by means of locknut and bushings or adapters, provided with grounding bushings. Connect bushings with a bare grounding conductor to the equipment ground box.

3.3 SECONDARY EQUIPMENT AND CIRCUITS:

- A. Main Bonding Jumper: Connect the secondary service neutral to the ground bus in the service equipment.
- B. Water Pipe and Supplemental Electrode:
 - 1. Provide a ground conductor connection between the service equipment ground bus and the metallic water pipe system. Jumper insulating joints in the water pipe.
 - 2. Provide a supplemental ground electrode and bond to the water pipe ground, or connect to the service equipment ground box.
- C. Service Disconnect: Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors. Connect the neutral to the ground bus (main bonding jumper).
- D. Switchgear, Switchboards, and Unit Substations:
 - 1. Connect the various feeder green grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
 - 2. Connect the grounding electrode conductor to the ground bus.
 - 3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and ground wire to the ground bus.
- E. Transformers:
 - 1. Exterior: Exterior transformers supplying interior service equipment shall also have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
 - 2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest cold water pipe.

- F. Conduit Systems:
1. Ground all metallic conduit systems.
 2. Non-metallic conduit systems shall contain a grounding conductor.
 3. Conduit provided for mechanical protection containing only a grounding conductor, bond to that conductor at the entrance and exit from the conduit.
- G. Feeders and Branch Circuits: Install green grounding conductors with feeders and branch circuits in all feeders and branch circuits and in any raceway containing a phase conductor.
- H. Isolated Grounds: All isolated grounds must be insulated and must terminate on isolated ground buses in the equipment. No other equipment grounds shall be connected to isolated ground bus where isolated grounds are shown and PVC conduit is used, an additional equipment ground must be installed to ground metallic boxes and mounting straps.
- I. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the grounding wires to each pullbox, junction box, outlet box, cabinets, and other enclosures through which the ground wires pass (except for special grounding systems for intensive care units and other critical units shown.).
 2. Make ground wire connections to ground bus in motor control centers.
- J. Receptacles and toggle switches are not approved for grounding through their mounting screws. Ground with a ground wire from green ground terminal on the device to the outlet box ground screw.
- K. Ground lighting fixtures to the green grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixture connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

- L. Fixed electrical appliances and equipment shall have a ground lug installed for termination of the green ground conductor.
- M. Telephone Terminal Boards: Provide a #6 cu. ground in 3/4" c. from each board to the main service disconnect ground bus.

3.4 CONDUCTIVE PIPING:

- A. Bond all conductive piping systems in the building to the electrical system ground. Bonding connections shall be made as close as practical to the water pipe ground or service equipment ground bus.

3.5 GROUNDING RESISTANCE:

- A. Grounding system ground resistance must not exceed 5 ohms. Final tests shall assure that this requirement is met. Submit to the engineer.
- B. Where permanently ground connections are required, make the connections by the exothermic process to form solid metal joints.
- C. Where rock prevents the driving of vertical ground rods, install grounding electrodes in horizontal trenches to achieve the specified resistance.
- D. Where more than one ground rod is required to meet the specified resistance, they shall be located at least 10 feet apart.

END OF SECTION 16450

SECTION 16460 - TRANSFORMERS (GENERAL PURPOSE)

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes the furnishing, installation, and connection of the dry type general purpose transformers.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE DRY TYPE TRANSFORMERS:

- A. Unless otherwise specified, shall be in accordance with NEMA, NEC, and as shown on the drawings. Transformers shall be UL listed or labeled.
 - 1. Approved Manufacturers are Square 'D', Siemens, I.T.E., General Electric, Cutler Hammer, Challenger, Westinghouse or Acme.
 - 2. All transformers must be protected on the primary side, by a Class 'L' or 'J' time delay fuse or current limiting breaker. Manufacturer shall size and coordinate to allow transformer inrush and protect from transformer damage. Submit coordination curve with shop drawing. Shop drawings shall also include impedance and maximum secondary fault current. Manufacturer must add fusible disconnect on primary if not shown on drawings.
- B. Shall have the following features:
 - 1. Self-cooled by natural convection, isolating windings, indoor, dry type. Autotransformers shall not be accepted.
 - 2. Rating and winding connections shall be as shown on the drawings.
 - 3. Ratings shown on the drawings are for continuous-duty without the use of cooling fans.
 - 4. Class H insulation: Temperature rise shall not exceed 115 degrees C above 40 degree's C ambient for 0-10 KVA transformers, 150 degrees C for 15-112.5 KVA transformers, and 80 degrees C for larger transformers, with limiting temperature of 220 degrees C in accordance with NEMA Standards. Transformer enclosure warm spot shall not exceed 35 degrees C. rise above a 30 degrees C. ambient.

5. Core and coil assemblies:
 - a. Rigidly braced to withstand the stresses caused by short circuit currents and rough handling during shipment.
 - b. Cores shall be grain oriented, non-aging, silicon steel.
 - c. Coils shall be continuous windings without splices except for taps.
 - d. Coil loss and core loss shall be optimum for efficient operation.
 - e. Primary, secondary and tap connections shall be brazed or pressure type.
 - f. Coil windings shall have end fillers or tie downs for maximum strength.
6. Certified sound levels determined in accordance with NEMA, that do not exceed the following:

Transformer Ratings	Sound Level Rating
0 - 9 KVA	40 dB
10 - 50 KVA	45 dB
51 - 150 KVA	50 dB
151 - 300 KVA	55 dB
301 - 500 KVA	60 dB

7. Nominal impedance shall be as permitted by NEMA.
8. All transformers rated 30 KVA and larger shall have two, 2-1/2 percent full capacity taps above, and four, 2-1/2 percent full capacity taps below normal rated primary voltage.
9. Core assemblies shall be grounded to their enclosures by adequate flexible, ground straps.
10. Enclosures:
 - a. Not less than code gage steel.
 - b. Temperature rise at hottest spot shall conform to NEMA Standards.

- c. Ventilation openings shall prevent accidental access to live components.
 - d. Thoroughly clean and paint at the factory with manufacturer's prime coat and standard finish.
- 11. Standard NEMA features and accessories including ground pad, lifting provisions and nameplate with the wiring diagram sound level indicated on it.
 - 12. Dimensions and configurations shall conform to the spaces designated for their installations.

2.2 NON-LINEAR LOAD TRANSFORMERS TYPE NL AND NLP:

- A. Furnish and install, as indicated on the electrical plans, dry-type transformers type (NL) or type (NLP).
 - 1. Approved Manufacturers are MGM, Square 'D', Acme, General Electric, Challenger and Westinghouse.
 - 2. All transformers must be protected on the primary side, by a Class 'L' or 'J' time delay fuse. Manufacturer shall size to allow transformer inrush and protect from transformer damage. Submit coordination curve with shop drawing. Shop drawings shall also include impedance and maximum secondary fault current. Manufacturer must add fusible disconnect if not shown on drawings.
- B. Transformer coils shall be of the continuous wound construction and shall be impregnated with nonhygroscopic, thermosetting varnish.
- C. Transformers 15 KVA and larger shall have a minimum of 6-2.5% full capacity primary taps for 480V primaries. Exact voltages to be as designated on the plans or the transformer schedule.
- D. Ratings:
 - 1. Transformer insulation shall be a UL recognized 220·C system. Neither the primary nor the secondary temperature shall exceed 220·C at any point in the coils while carrying their full rating of non-sinusoidal load. The maximum temperature hot spot temperatures shall not exceed the following values for the indicated K factors, defined as the sum of fundamental and harmonic $I_h (pu)^2 h^2$ per ANSI/IEEE C57.110-1976.

Hot Spot Temperature	K Factor Rating	
	NL	NLP
220 C	4.0	13.0
185 C	3.2	9.6
150 C	2.7	6.9

Manufacturers rating K factors by average temperature rise alone shall not be acceptable.

E. Construction:

1. All cores to be constructed with low hysteresis and eddy current losses. The core flux density shall be well below the saturation point to prevent core overheating caused by harmonic voltage distortion. Manufacturers shall submit verification of induction levels well below the usual level for standard transformers.
2. Transformers shall be common core construction. Transformers utilizing more than one core, or Scott-T connections, shall not be acceptable.
3. The transformer secondary neutral terminal shall be sized for 200% of the secondary phase current.
4. The transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. The entire enclosure shall be finished utilizing a continuous process consisting of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of a polymer polyester powder coating and baking cycle to insure uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use. The coating color shall be ANSI 49.
5. The maximum temperature of the top of the enclosure shall not exceed 50·C rise above a 40·C ambient.
6. Transformers shall be supplied with a quality, full width electrostatic shield resulting in a maximum effective coupling capacitance between primary and secondary of 33 picofarads. With transformers connected under normal, loaded operating conditions, the attenuation of line noise and transients shall equal or exceed the following limits:
 - a. Common Mode: 0 to 1.5HZ - 120db; 1.5HZ to 10KHZ-90db; 10KHZ to 100 KHZ-65db; 100KHZ to 1MHZ-40db

- b. Transverse Mode: 1.5KHZ to 10KHZ-52db; 10KHZ to 100 KHZ-300db; 100KHZ to 1MHZ-30db.
- 7. Sound levels shall be guaranteed by the manufacturer not to exceed the following: 15 to 50KVA-45db; 51 to 150KVA-50db; 151 to 300 KVA-55db; 301 to 500 KVA-60db. Note: Lower sound levels may be desirable for critical areas such as hospitals, schools or office areas.

F. Standards:

- 1. All insulation materials are to be in accordance with NEMA ST20 standards for 220·C UL component recognized insulation system. Transformers are to be manufactured and tested in accordance with ANSI Standard C57.12.91 and NEMA ST20.
- 2. Transformers shall be listed by Underwriters Laboratory.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, and as shown on the drawings.
- B. Install the transformers with adequate clearance for air circulation to remove the heat produced by transformers.
- C. Install floor mounted transformers on 3 1/2" high housekeeping concrete pad.
- D. Use flexible metal conduit to contain the conductors from the transformer to the raceway system.

END OF SECTION 16460

SECTION 16462 - DISTRIBUTION SWITCHBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes the furnishing, installation, and connection of the distribution switchboards.

1.2 APPROVED MANUFACTURERS:

Square 'D'
Siemens/I.T.E.
General Electric
Cutler Hammer
Westinghouse
Challenger.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Switchboards shall be in accordance with UL, NEMA, NEC, ANSI, and as shown on the drawings.
- B. Switchboards shall be provided complete, ready for operation including, but not limited to housing, buses, circuit breakers, switches, instruments and related transformers, fuses, and wiring.
- C. Switchboard dimensions shall not exceed the space provided as shown on the drawings.

2.2 BASIC ARRANGEMENT:

- A. Type II: Switchboard shall not be rear accessible (with no renewable parts serviced from the rear) with the following features:
 - 1. Device mounting:
 - a. Main breaker/switch: Individually mounted and compartmented.
 - b. Feeder breakers/switch: Panel mounted.

2. Section alignment: As shown on drawings.
3. Accessibility:
 - a. Main section line and load terminals: Front/rear.
 - b. Distribution section line and load terminals: Front.
 - c. Bus connections: Front/rear.
4. Short Circuit Current Rating: 100,000 amperes rms symmetrical, minimum (or as shown on plans).

2.3 HOUSING:

- A. Provide a completely enclosed, free standing, steel enclosure not less than the gage required by the standards. The enclosure is to consist of the required number of vertical sections bolted together to form one metal enclosed rigid switchboard. The sides, top and rear shall be covered with removable screw on sheet steel plates.
- B. Provide ventilating louvers where required to limit the temperature rise of current carrying parts. All openings shall be protected against entrance of falling dirt, water, or foreign matter.
- C. Group the meters and their control switches on a hinged front cover. Provide concealed hinges and latch.
- D. Painting: Thoroughly clean phosphate treat, and prime all steel with rust-inhibiting paint. Final finish coat to be the manufacturers standard gray.

2.4 BUSES:

- A. General: Buses shall be arranged for 3-phase, 4-wire distribution. Main phase buses (through bus), full size neutral bus, and ground bus shall be full capacity the entire length of the switchboard. Provide for future extensions by means of bolt holes or other approved method. Brace the bus to withstand the available short circuit current at the particular location and as shown on the drawings.

- B. **Material and Size:** Buses and connections shall be tin plated hard drawn copper of 98 percent conductivity or high strength tin plated aluminum. Bus temperature rise shall not exceed 65 degrees C. Current density shall not exceed 1200 amperes per square inch for copper or 750 amperes per square inch for aluminum. Section busing shall be sized based on the sum total of breakers served to permit operation of each unit at not less than 125 percent of its trip rating or 50 percent of the frame size, whichever is greater.
- C. **Bus Connections:** All contact surfaces of copper or aluminum shall be plated. Provide a minimum of two plated bolts per splice. Where physical bus size permits only one bolt, provide a means other than friction to prevent turning, twisting or bending. Make connections for aluminum bus with placed nuts and bolts with a flat plated steel washer against the bus and a bellville washer between the flat washer and nut. Torque bolts to the manufacturer's recommended values.
- D. **Neutral Bus:** Provide bare or plated bus and mount on insulated bus supports. Provide neutral disconnect link to permit isolation of neutral bus from the common ground bus and service entrance conductors.
- E. **Ground Bus:** Provide an uninsulated 1/4-inch thick copper equipment ground bus bar sized per UL 891 the length of the switchboard and secure at each section.
- F. **Main Bonding Jumper:** Connect an uninsulated 1/4-inch thick copper bus between the neutral and ground buses to establish the system common ground point.

2.5 NAMEPLATES:

- A. **Nameplates:** Provide laminated black phenolic resin with white core with 3/16-inch high engraved lettered nameplates for each circuit breaker (switch) to indicate the feeder, panelboards and equipment served. Mounted, with plated screws, adjacent to or on front of the breaker.

2.6 PROVISION FOR FUTURE:

- A. Where "provision for", "future", or "space" is noted on drawings, the space shall be equipped with bus connections to the future overcurrent device with suitable insulation and bracing to maintain proper short circuit rating and physical clearance. Provide buses for the ampere rating as shown for the future device.

2.7 BREAKER REMOVAL EQUIPMENT:

- A. Where draw out circuit breakers are provided, furnish a portable elevating carriage or switchboard mounted device for installation and removal of the breakers.

2.8 CONTROL WIRING:

- A. Control wiring shall be 600-volt Class B stranded SIS. Install all control wiring complete at the factory adequately bundled and protected. Wiring across hinges and between shipping units shall be class C stranded. Size in accordance with NEC. Provide control circuit fuses.

2.9 CIRCUIT BREAKERS:

- A. Type II Switchboard:

1. 300-1200 Amp: Square 'D' type 'NE' or 'ME' or equal. Circuit breakers shall be UL listed (category PAQX).
 - a. Rating shall be 3-pole, 600 volts AC, 60-cycle with indicated frame size, trip rating and system voltage. Interrupting rating shall be without instantaneous trip.
 - b. Position indicator: Provide an indicator visible from the front of the unit to indicate whether the breaker is open or closed.
 - c. Trip button: Provide a mechanical trip button accessible from the front of the door to trip the breaker.
 - d. Padlocking: Include provisions for padlocking the breaker in the open position.
 - e. Trip devices shall have the following features:
 - 1) Trip device in each pole.
 - 2) Mechanically and electrically trip free.
 - 3) Long time element with adjustable pick-up and selective maximum, intermediate, and minimum time delay bands.
 - 4) Short time element with adjustable pick-up and selective maximum, intermediate and minimum time delay bands.

- 5) Instantaneous trip point.
 - 6) Ground fault element with adjustable pick-up and selective maximum, intermediate and minimum time delay bands.
 - 7) Final settings of pick-up and time bands shall be as reflected by the Electrical System Protective Device Study.
2. 100 Amp and Smaller Breakers: Provide UL listed and labeled molded case circuit breakers, in accordance with the NEC, as shown on the drawings, and as herein specified.
- a. Molded case circuit breakers shall have non-adjustable automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 ampere frame size or less. Factory setting shall be LOW unless otherwise noted.
 - b. Breaker features shall be as follows:
 - 1) A rugged, integral housing of molded insulating material.
 - 2) Silver alloy contacts.
 - 3) Arc quenchers and phase barriers for each pole.
 - 4) Quick-make, quick-break, operating mechanisms.
 - 5) A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
 - 6) Electrically and mechanically trip free.
 - 7) An operating handle which indicates ON, TRIPPED and OFF positions.
 - 8) Line and load connections shall be bolted or plug on.
 - 9) Interrupting rating shall not be less than the maximum short circuit current available at the time terminals as shown on the electrical system protective device study.
 - 10) An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.

2.10 FUSIBLE SWITCHES:

- A. Refer to Section 16170.

2.11 METERING:

- A. Provide all current potential transformers, meters, and phase selector switches as shown on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install switchboards in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. Install a 3 1/2" high concrete housekeeping pad under all switchboards.
- C. Anchor switchboards to the floor with plated 1/2-inch minimum anchor bolts as recommended by the manufacturer.

3.2 INSTRUCTIONS:

- A. Furnish the services of a competent instructor for one 2-hour period for instructing personnel in the operation and maintenance of the switchboard on the date requested by the engineer.

END OF SECTION 16462

SECTION 16470 - PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes the furnishing, installation and connection of panelboards.

PART 2 - PRODUCTS

2.1 PANELBOARDS:

- A. Panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings. Approved manufacturers shall be as follows:

Branch Circuit Panel Rating	Square 'D'	Siemens ITE	Cutler-Hammer	General Electric	Westing-house and Challenger
240V (400A max.)	NQOD	S1&S3	PB	AQ	PL1
480V (200A max.)	NEHB	S2&S3	NHB	AE	PL2
Circuit Breaker Distribution Panel	I-Line	S4&S5	EE	CCB	PL4&PL3
Fusible Distribution Panel	QMB	F1&F2	MP	QMR	PL4F

- B. Minimum circuit breaker short circuit rating options: See the drawings for panel A.I.C. ratings.
1. Fully rated breakers.
 2. U.L. Series rated with Class 'J' or 'L' fuses.
 3. U.L. series rated with line side breakers.
 4. Panelboards and shop drawings shall have a U.L. label indicating the integrated equipment rating. If U. L. Series ratings are used the shop drawings shall clearly indicate the rating used and that it is U.L. Listed. Panelboard nameplates shall clearly indicate the A.I.C. rating of the panel and the method used to rate the panel (Example: "50,000 AIC with 22 KA Breakers and Class 'J' fuses".)

- C. Provide standard manufactured products. All components of panelboards shall be the product and assembly of the same manufacturer. All similar units of all panelboards to be of the same manufacturer.
- D. All panels shall be dead front safety type. Arrange sections for easy removal without disturbing other sections. All distribution panels in finished areas shall be provided with key locking doors. All panels in finished areas shall be recessed with flush type covers.
- E. All panelboards shall be completely factory assembled with molded case circuit breakers or switches.
- F. Panels shall have main breaker/switch or main lugs, bus size, voltage, phase, top or bottom feed, and flush or surface mounting as scheduled on the drawings.
- G. Panelboards shall have the following features:
 - 1. Non-reduced size tin plated copper or aluminum bus bars, and connection straps bolted together and rigidly supported on molded insulators. Bus bar tops for panels with single pole branches shall be arranged for sequence phasing of branch circuit devices.
 - 2. Full size neutral bar, mounted on insulated supports.
 - 3. Ground bar with sufficient terminals for all grounding wires.
 - 4. Buses braced for the available short circuit current as listed on the drawings, but not less than 22,000 amperes symmetrical for 208V. or 240V. branch circuit panelboards, 14,000 amperes symmetrical for 480V. branch circuit panelboards, 100,000 for circuit breaker distribution panelboards or 200,000 for fusible distribution panelboards.
 - 5. Distribution panels located in finished rooms (other than mechanical, electrical rooms or janitor rooms) shall be provided with key locking doors.
 - 6. All breakers and phase bus connections shall be arranged so that it will be possible to substitute a 2-pole breaker for two single pole breakers, and a 3-pole breaker for three single pole breakers, when trip is 60 amps or less and frame size is 100 amperes or less, without having to drill and tap the main bus bars at bus straps.

7. Design interior so that protective devices can be replaced without removing adjacent units, main bus connectors, and without drilling or tapping. Panel phase bus connections to protective devices shall not be riveted to the panel bus and shall be field removable by means of a screw driver.
8. Where designated on panel schedule as "space", include all necessary bussing, device support, and connections. Provide blank cover for each space.
9. In two section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side with cable connections to the second section. Panelboard sections with tapped bus or crossover bus shall not be accepted.
10. All panelboards supplied from an emergency source shall have breakers provided with handle lock-offs for each breaker. Breaker handles to be set in the "ON" position.

2.2 CABINETS AND TRIMS:

A. Cabinets:

1. Provide galvanized steel cabinets to house panelboards. Cabinets for distribution panels may be factory primed and suitable treated with a corrosion-resisting point finish meeting UL standard for outdoor applications.
2. Cabinet enclosure shall not have ventilating openings (225A. and less).
3. Back and sides shall be of one piece formed steel. Cabinets for distribution panels may be of formed sheet steel with end and side panels welded, riveted, or bolted as required.
4. Provide minimum of four interior mounted studs and necessary hardware for "in" and "out" adjustment of panel interior.
5. Cabinets for two section panelboards shall have both sections bolted together, arranged side by side, and shall be the same height. Flush mounted cabinets should be 1-1/2 inches apart and coupled by conduit nipple.
6. Gutter size in panel boxes, on all sides, shall be in accordance with the NEC. Cabinets containing through feeders shall have the gutters space increased by the amount required for auxiliary gutters in the NEC.

B. Trims:

1. Fabricate trim of sheet steel consisting of frame with door-in-door construction attached by concealed hinges. Provide flush or surface trim as shown on the drawings.
2. Flush trims shall overlap the box by at least 3/4-inch all around.
3. Surface trim shall have the same width and height as the box. Trim overlap or protruding past the box sides will not be allowed.
4. Flush or surface trims shall not have ventilating openings (225A. and less).
5. Secure trims to back boxes by indicating trim clamps.
6. Provide a welded angle on rear of trim to support and align trim to cabinet.
7. Provide separate trims for each section of multiple section panelboards. Trims and doors of sections shall be of the same height.
8. All trims for circuit breaker panelboards 400 Amp and less shall be door in door construction with a concealed piano hinge on the left side.

C. Doors:

1. Provide doors with flush type latch and manufacturer's standard lock. Doors over 48 inches in height shall have a vault handle and a three point catch, arranged to fasten door at top, bottom, and center. Doors are not required on distribution panelboards except in finished rooms.
2. In making switching devices accessible, doors shall not uncover any live parts.
3. Provide concealed, butt hinges welded to the doors and trim.
4. For magnetic contactors incorporated in panelboards, provide separate doors for the contactors.
5. Provide keyed alike system for all panelboards. In existing buildings where new panels are installed, provide keyed alike locks as directed by engineer.
6. Provide a typed directory card, metal holder, and transparent cover. Permanently mount holders on inside of doors.

D. Painting:

1. Thoroughly clean and paint trims and doors at the factory with primer and manufacturer's standard finish.

2.3 MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS:

A. Breakers shall be UL listed and labeled, in accordance with the NEC, as shown on the drawings, and as specified.

B. Circuit breakers in panelboards shall be bolt on type on phase bus bar or branch circuit bar.

1. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 ampere frame or less. Magnetic trip shall be adjustable for breakers with 400 ampere frames and higher. Factory setting shall be HI, unless otherwise noted.
2. Molded case circuit breakers for lighting circuits shall be switching duty rated and suitable for use on HID lighting circuits.

C. Breaker features shall be as follows:

1. A rugged, integral housing of molded insulating material.
2. Silver alloy contacts.
3. Arc quenchers and phase barriers for each pole.
4. Quick-make, quick-break, operating mechanisms.
5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates ON, TRIPPED, and OFF positions.
8. Line connections shall be bolt-on.
9. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.

2.4 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS:

- A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with applicable requirements of those specified for panelboards.
- B. Enclosures are to be of the NEMA types shown on the drawings. Where the types are not shown, they are to be the NEMA type most suitable for the environmental conditions where the breakers are being installed.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with NEC, as shown on the drawings, and as specified.
- B. Where flush mounted panels occur on drawings contractor shall stub into ceiling void for future use, (1) 1" empty conduit for every four spare 20A. breakers or unused panel space.
- C. Locate panelboards so that the present and future conduits can be conveniently connected. Coordinate the sizes of cabinets with designated closet space.
- D. Install a typewritten schedule of circuits in each panelboard after approval by the engineer. Schedule shall be typed on the paper directory cards. Include the room numbers and items served on the cards.
- E. Mount the panelboard so that maximum height of circuit breaker or switch above finished floor shall not exceed 78 inches. For panelboards which are too high, mount panelboard so that the bottom of the cabinets will not be less than six inches above the finished floor.
- F. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims, doors, and boxes with finishes to match surrounding surfaces after the panelboards have been installed.
- G. Circuit numbers indicated on the drawings are shown for the purpose clarifying the grouping of outlets. The actual number assigned to the circuit in the panelboard shall suit the bussing and branch circuitry to the panel.

END OF SECTION 16470

SECTION 16480 - MOTORS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section applies to all motors that are not directly specified or when referenced by other sections.

PART 2 - PRODUCTS

2.1 MOTORS:

- A. For alternating current, fractional and integral horsepower motors. Fed. Spec. CC-M-1807, NEMA Publications MG1 and MG2 shall apply.
- B. Voltage ratings shall be as follows:
 - 1. Single phase:
 - a. Motors connected to 120 volt systems: 115 volts.
 - b. Motors connected to 208 volt systems: 200 volts.
 - c. Motors connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.
 - 2. Three phase:
 - a. Motors connected to 208 volt systems: 200 volts.
 - b. Motors, less than 100 HP, connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.
 - c. Motors, 100 HP or larger, connected to 480 volt systems: 460 volts.
- C. Number of phases shall be as follows:
 - 1. Motors, 1/2 HP and less: Single phase, 120 volt.
 - 2. Motors, larger than 1/2 HP: 3 phase, 480 volt (208 or 240 volt when 480 volt distribution not used).

3. Exceptions:
 - a. Hermetically sealed motors.
 - b. Motors for equipment assemblies, less than one HP, may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.
- D. Horsepower ratings shall be adequate for operating the connected loads continuously in the prevailing ambient temperatures in areas where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulations.
- E. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque's.
- F. Motor Enclosures:
 1. Shall be the NEMA types shown on the drawings for the motors.
 2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types which are most suitable for the environmental conditions where the motors are being installed.
 3. Thoroughly clean and paint the enclosures at the factory with manufacturer's prime coat and standard finish.
- G. Additional requirements for specific motors, as indicated in other sections, shall also apply.
- H. Energy-Efficient Motors: When higher than standard efficiency motors are specified or indicated, they shall be rated using the IEEE Standard No. 112, Method B, test procedures, as detailed in NEMA MG1, 12.53.a. The nameplate shall identify the NEMA Nominal Efficiency indicated on the drawings.
- I. Motors connected and controlled by variable frequency drives shall be NEMA Design 'B', and U.L. Listed inverter duty rated motors for 'PWM' drives with motor winder heater overloads and with 1600 volt insulation.

2.2 POWER FACTOR:

- A. Each motor as indicated in Section 16410 shall be supplied at 95% power factor by the equipment supplier or power factor correction, meeting the requirements of Section 16410 - shall be provided by the power factor to 95%. (Exception: this does not apply to motors controlled by frequency drives.)

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and as required by other sections of these specifications.

END OF SECTION 16480

SECTION 16481 - MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes all motor starters and motor control stations, either stand alone in NEMA enclosures, combination type with disconnect, or in panelboards or motor control centers.

PART 2 - PRODUCTS

2.1 MOTOR STARTERS:

- A. Approved manufacturers: Square 'D', Cutler Hammer, Furnas, Siemens/ITE, General Electric, Westinghouse and Allen Bradley. NEMA and NEC shall apply.
- B. All starters shall be fully NEMA rated, shall have all components made by one manufacturer, and shall have the following features:
 - 1. Enclosed type as shown on the drawings.
 - 2. Safety switches within the motor controller enclosures shall have external operating handles with lock-open padlocking provisions and shall indicate the ON and OFF positions.
 - 3. Motor control circuits:
 - a. Shall operate at not more than 120 volts.
 - b. Shall be grounded except as follows:
 - 1) Where isolated control circuits are shown.
 - 2) Where manufacturers of equipment assemblies recommend that the control circuits be isolated.
 - c. Incorporate a separate, heavy duty, control transformer within each motor controller enclosure to provide the control voltage for each motor operating over 120 volts.
 - d. Incorporate primary and secondary overcurrent protection for control power transformers in accordance with the NEC.

4. Overload current protective devices:
 - a. Thermal or induction type Class 20.
 - b. One for each pole.
 - c. Manual reset on the door of each motor controller enclosure.
 - d. Correctly sized for the associated motor's rated full load current.
 - e. Check every motor controller after installation and verify that correct sizes of protective devices have been installed.
5. Auxiliary contacts, H-O-A selector switches, green on pilot light and push-buttons.
6. Other devices and accessories as shown on the drawings or otherwise required by control drawings and approved shop drawings.
7. Enclosures:
 - a. Shall be NEMA 1 for interior, NEMA 3R for exterior and other types as shown on the drawings for the motor controllers.
 - b. Where the types of motor controller enclosures are not indicated, they shall be the NEMA types which are the most suitable for the environmental conditions where the motor controllers are being installed.
 - c. Doors shall be mechanically interlocked to prevent opening unless the breaker or switch within the enclosure is open.
 - d. Thoroughly clean and paint the enclosures at the factory with manufacturer's prime coat and standard finish.
8. Each controller for motors 10 HP and larger shall be equipped with a 3 phase sensing loss of phase relay with automatic reset. Equal to Time Mark model 258.

- C. Motor controllers incorporated with equipment assemblies shall also be designed for the specific requirements of the assemblies.
- D. Additional requirements for specific motor controllers, as indicated in other sections, shall also apply.
- E. Install a disconnect safety switch near and within sight of each motor. Combination type switch/starter in one enclosure are acceptable if listed as one piece. Switches shall comply with Section 16400.
- F. Two speed starters shall be of the type as required for the actual motor installed. Verify in the field.
- G. If motor is dual winding, provide three additional phase conductors of the same size and type as specified to the starter, and provide the proper type of starter for the motor supplied. Increase conduit as required.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, and as shown on the drawings.

END OF SECTION 16481

SECTION 16482 - MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes the furnishing, installation, and connection of the motor control centers.

1.2 MANUFACTURERS:

- A. Approved Manufacturers are Square 'D', General Electric, Cutler Hammer, Allen Bradley, Westinghouse, Siemens/ITE and Furnas.

PART 2 - PRODUCTS

2.1 MOTOR CONTROL CENTERS:

- A. Motor control centers shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.
- B. Motor control centers shall be complete, floor-mounted, metal-enclosed, grounded, indoor type. The motor control centers shall be NEMA Standard, Class 1, Type B except where other NEMA Standard classes and types are shown on the drawings.
- C. Ratings shall be not less than shown on the drawings. Interrupting ratings shall be not less than the maximum short circuit currents available where installing the centers, as shown on the drawings.
- D. Shall conform to the arrangements and details of the drawings and to the spaces designated for installation.
- E. Shall be designed to withstand the mechanical stresses caused by rough handling during shipment in addition to the electrical and mechanical stresses which will occur during operation of the centers.
- F. Coordinate components of the centers and their arrangements electrically and mechanically. The components and the control wiring shall conform to the approved shop drawings as furnished for the various, applicable electrical and mechanical sections of the specifications.
- G. Assemble, connect and wire the centers at the factory in accordance with the NEMA Standard class and type for each of the centers.

- H. Thoroughly clean, phosphatize and paint the metal surfaces at the factory with primer and baked enamel or lacquer finishes.
- I. Shall have the following features:
 - 1. Standard Vertical Sections:
 - a. Approximately 90 inches high, front and rear line-up, fabricated by a single manufacturer.
 - b. Rugged steel assemblies with bracing, reinforcing gussets and jig-welding to assure rectangular-rigidity. The sections shall be completely metal-enclosed, including their bottoms.
 - c. Steel shall be not less than code gage, leveled.
 - d. Bolts, nuts and washers shall be rustproof metal.
 - e. Spaces within the sections shall be suitable and adequate.
 - f. Mount the sections on adequate structural steel supports at the factory, front and rear, for the full length of each center. Install the centers so the supports will rest on top of the concrete floor surfaces except where concrete pads are indicated. Anchor the centers with bolts, not less than 1/2-inch diameter.
 - g. Each present and future motor controller shall have an individual door with hinges and latches.
 - h. End panels shall be screw-removable to facilitate future additions.
 - i. Removable panels shall have screws which remain in the panels when the panels are removed. Screws shall be received by self-aligning, self-retaining nuts attached within the assemblies.
 - j. Isolated vertical full height wiring troughs.
 - 2. Bus Bars and Interconnections:
 - a. Shall be tin plated copper or aluminum.

- b. Shall be totally enclosed.
 - c. Bus bar joints and interconnection joints shall be plated, constant high-pressure type with high strength copper-silicon bolts, and nuts. Bellville type plated conical washers under the nuts and over plated flat steel washers against the aluminum shall be used for aluminum bus.
 - d. Insulation:
 - 1) High strength polyester glass or equal.
 - 2) High track-resistance.
 - 3) High impulse and dielectric strength, especially at elevated temperatures, for withstanding the maximum short circuit currents.
 - 4) High flame-retardant, self-extinguishing.
 - 5) NEMA Standard for 65 degree C temperature rise shall apply.
 - e. Shall have horizontal main buses and vertical bus for connecting the motor controllers, circuit breakers and switches.
 - f. Shall have an adequate ground bus which extends across the entire width of each center.
 - g. Bus bars shall be designed to extend to additional sections when so shown on the drawings.
 - h. Temperature rises shall not exceed the NEMA Standards.
3. Completely equipped spaces for future motor controllers, circuit breakers and switches.
4. Motor Controllers:
- a. Stab-on type except for large ratings which require bolted connections.
 - b. Shall conform to the applicable requirements in SECTION, 16481 MOTOR CONTROLLERS.

- c. Products of a single manufacturer.
 - d. Interchangeable for the same ratings in all of the motor control centers being installed for this contract.
 - e. Disconnecting contact devices:
 - 1) Silver-plated copper, full-floating, self-aligning, self-coupling, designed for cleaning action during engaging and disengaging movements.
 - 2) Adequate flexibility between the stationary and movable components.
 - 3) Adequate pressure maintained on the contacts.
 - 4) Shall engage silver plated buses.
 - f. Doors mechanically interlocked to prevent their opening unless the disconnect is opened. Incorporate 'defeater' mechanisms for inspection by qualified personnel.
 - g. External operating handles with lock-open padlocking provisions and ON and OFF position indicators.
5. Fusible Disconnects: Shall conform to applicable requirements in Section 16170.
6. Identify each motor controller, circuit breaker, or switch with a separate nameplate of laminated black phenolic resin with white core and engraved lettering not less than 3/16-inch high. Identify each motor by its number or other designation and indicate function fulfilled by the motor. Identify pilot light with on and off designation.
- J. Test the motor control centers at the factory to assure that the centers do not have any defects.
- K. A.I.C. ratings and labels shall be as shown on the drawings, 65000 A.I.C. minimum.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with NEC, and as shown on the drawings.
- B. Install a 3 1/2" high concrete housekeeping pad under all MCC's.
- C. Anchor MCC to the floor with plated 1/2 inch minimum anchor bolts as recommended by the manufacturer.

END OF SECTION 16482

SECTION 16510 - BUILDING LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes the furnishings, installation of and connection of all building lighting.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES:

- A. Shall conform to the detail drawings, NEC Article 410 and UL-57.
- B. Sheet Metal:
 - 1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
 - 2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
 - 3. Where lighting fixture types are detailed with minimum 20 gauge (0.035 inch) housing, minimum 22 gauge (0.029 inch) housings will be acceptable provided they have strengthening embossed rib and break formations, and meet the rigidity test requirements of Fed. Spec. W-F-1662.
 - 4. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
 - 5. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, and latches shall function easily by finger action without the use of tools.
- C. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.

D. Lamp Sockets:

1. Fluorescent: Lampholder contacts shall be the biting edge type or phosphorous-bronze with silver flash contact surface type and shall conform to the applicable requirements of UL 542 and ANSI C-81. Contacts for recessed double contact lampholders and for slimline lampholders shall be silver plated. Lampholders for bi-pin lamps, with the exception of those for "U" type lamps, shall be of the telescoping compression type, or of the single slot entry type requiring a one quarter turn of the lamp after insertion.
2. High Intensity Discharge (H.I.D.): Shall have porcelain enclosures and conform to the applicable requirements of ANSI C-81.
3. Incandescent: Shall have porcelain enclosures and conform to the applicable requirements of UL 496.

E. Recessed incandescent fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

F. Fluorescent fixtures with louvers or light transmitting panels shall have doors with hinges, latches and safety catches to facilitate safe, convenient cleaning and relamping. Vaportight fixtures shall have pressure clamping devices in lieu of the latches.

G. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

H. Metal Finishes:

1. The manufacturer shall apply his standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking.
2. Fluorescent fixtures shall be completely post painted with electrostatically applied and baked enamel. No exceptions.
3. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.

4. Exterior finishes shall be as shown on the drawings.

I. Ballasts for Fluorescent Fixtures:

1. All ballasts serving straight or "U" type lamps, nominal three feet (socket to socket) or longer in tube length, shall be securely mounted by nonturning studs (or captive bolts) equipped with lockwashers and nuts or locking type nuts, or by thread cutting (TC) sheet metal screws which are firmly secured against the fixture body (or wireway) to maximize dissipation of heat and minimize noise.
2. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
3. To facilitate multi-level lamp switching, lamps within fixture shall be wired with the outermost lamp at both sides of the fixture on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled.
4. Where three-lamp fixtures are indicated, unless switching arrangements dictate otherwise, utilize a common two-lamp ballast to operate the center lamp in pairs of adjacent units. The ballast fixture and slave lamp fixture shall be factory wired with leads or plug devices to facilitate this circuiting. Individually mounted fixtures and the odd fixture in a row shall utilize a single lamp ballast for operation of the center lamp.
5. Core and coil ballasts :
 - a. Shall be rapid starting type or instant start for //T8 T12// lamps.
 - b. Shall be UL Class P with automatic resetting, internal, thermal protection.
 - c. Shall conform to ETL-CBM label requirements.
 - d. Power factors shall be not less than 90 percent. Capacitors in ballasts shall not contain PCB (Polychlorinated Biphenyl) fluids or other fluids recognized as hazardous when discharged into the environment.

- e. Sound ratings shall be A, except for ballast sizes which are not available with A ratings, as standard products from any manufacturer. Ballasts which are not available with A ratings shall have the quietest ratings available.
 - f. One and two lamp ballasts shall be energy-saving type, UL listed to operate the specified lamps. Lamp output shall be within 5 percent of nominal rating. When operating two energy-saving lamps, the input watts to the ballast shall not exceed 78 watts at 120 V.A.C. or 79 watts at 277 V.A.C. Energy-saving type ballasts should not be used in ambient temperatures below manufacturer's recommendations. Low temperature -0· ballasts shall be used in all exterior and unheated spaces.
6. High-Frequency electronic ballasts (for operation only of the specified lamps):
- a. Ballasts shall operate the lamps at a frequency between 20 and 40 KHz from an input frequency of 60Hz.
 - b. Ballast package:
 - 1) Size: The ballast case shall be sized to be physically interchangeable with standard core and coil ballasts and suitable for standard mounting in new or existing lighting fixtures.
 - 2) Case marking: Mark the ballast to indicate the required supply voltage, frequency, RMS current, current surge during starting, input watts, and power factor at the design center voltage, open circuit voltage, crest factor and efficacy.
 - c. Performance:
 - 1) Light output:
 - a) At the design voltage, the light output shall be at least equal to that obtained by a core-and coil ballasted system meeting ANSI and CBM standards. The comparison test shall be measured in the same fixture at 25 degrees C (plus or minus one degree) ambient room temperature.

- b) Tests shall be made in fixtures designed only for the number of lamps being tested.
 - c) For other applications (higher ambients, etc.) the tests should be operated with equivalent lamp wall temperatures plus or minus 4 degrees C.
- 2) Efficacy: The efficacy of the high-frequency, electronically ballasted system shall be at least 15 percent greater than the equivalent CBM core-and-coil ballasted system (see "Light output" above).
 - 3) Starting: The ballast shall be capable of starting the specified lamps at an ambient temperature of 50 degree F or more for an input voltage of plus or minus 10 percent about the center design voltage. The ballast shall never be started in the instant start mode at any temperature. Provide 0· ballasts where indicated on the drawings.
 - 4) Operation:
 - a) The ballast shall safely and reliably operate in a room ambient temperature from 50 degree F to 105 degree F.
 - b) The light output shall not vary by more than plus or minus 15 percent for a plus or minus 10 percent variation of the input voltage about the center design voltage.
 - c) The ballast shall operate the lamps in a manner that will not adversely curtail the normal life of the lamp.
 - 5) Surge withstand capability: The ballast shall be able to withstand a single input surge of 6,000 volts from a 50 ohm 50 KHz damped sinewave source.
 - 6) Flicker: The flicker shall be less than 5 percent.

- 7) Noise: The audible noise levels should be equivalent to the Class A rating of CBM certified ballasts.
 - 8) Electromagnetic interference (EMI): The EMI, conducted and radiated, shall meet the Federal Communication Commission's Part 18 Subsection H.
 - 9) Rated life: The ballast shall have a rated life of 10 years or 30,000 hours (based on a 10 hour day).
 - 10) Rated No. of Lamps: For 3 and 4 lamp fixtures, use 3 and 4 lamp ballasts wherever possible.
 - 11) Power factor: Not less than 90 percent.
- d. Reliability:
- 1) Labels: Ballasts must be labeled or listed by UL or ETL.
 - 2) Submit, simultaneously with shop drawings, a certified test report by an independent testing laboratory showing that the electronic ballasts meet or exceed all the performance requirements in this specification.

J. Ballasts for High Intensity Discharge Fixtures:

1. Shall have individual overcurrent protection sized in accordance with the manufacturer's recommendations.
2. Shall have integral thermal protection where the fixture is recessed in an interior ceiling.
3. Shall be the constant wattage, high power factor type or the reactor high power factor type. Capacitors shall not contain PCB (Polychlorinated Biphenyl) fluids or other fluids recognized as hazardous when discharged into the environment.
4. Shall have not less than B sound ratings for interior fixtures, when available. Ballasts which are not available with B ratings shall be of the highest available rating.

K. Provide all lighting fixtures with a specific means for grounding their metallic wireways and housings to an equipment grounding conductor.

L. Lighting Transmitting Components for Fluorescent Fixtures:

1. Shall be 100 percent virgin acrylic plastic and nominal .125 inch thick. Styrene lenses shall not be provided for any fixture.
2. Unless otherwise specified lenses and diffusers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction of the lens without distortion or cracking. At final inspection, all lens that sag or do not lay down flat and lens that sag shall be replaced by the manufacturer.

2.2 LAMPS:

A. Fluorescent Lamps:

1. Except as indicated below or on the drawings, standard lamps shall be T8 or T12 as specified on the drawings; by Sylvania, General Electric or Phillips; having a color temperature 3500 degrees Kelvin as specified on the drawings, a color rendering index (CRI) not less than 69 and an initial lumen output not less than 2900. Type F "U" tube lamps shall have the same color temperature and CRI limits as the above.

B. High Intensity Discharge Lamps:

1. In all cases, provide lamps that are approved by and designed for by the fixture manufacturer. Typically lamps for interior down lights shall be coated, those for exterior and industrial fixtures shall be clear.
2. Metal halide lamps for interior use shall be Metalarc/c coated. Metal halide lamps for exterior use shall be clear.
3. High pressure sodium lamps shall be as defined on the drawings.

C. Incandescent lamps shall be the general service, inside frosted type rated 125 volts except where otherwise shown on the drawings.

2.3 LIGHTING CONTROL EQUIPMENT:

A. See the drawings for the arrangement and method of control. Controls shall operate at 120 volt. Connect to the nearest 120 volt panel or as shown on the drawings.

B. Contactors And Relays:

1. Shall be as manufactured by Cutler-Hammer, Allen Bradley, G.E., Westinghouse or Square 'D'. They shall be as sized on the drawings.

2 All contactors and relays shall be Tungsten rated.

C. Time Switches:

1. Time switches by Tork, Intermatic, and Paragon equal to those listed on the drawings or indicated below and approved by the engineer will be acceptable.
2. Exterior lighting or interior time switches shall be Paragon EC 7000 Series 7 day 20A., SPDT.
3. All time switches shall be provided with momentary contacts if required.
4. All time switches shall be provided with manual bypass switches and spring wound carry over mechanisms.
5. Astronomical time clocks shall be used in all cases when a photo cell is not used and exterior lights or lights in a skylight are controlled. Equal to Intermatic #V45471CR.

D. Photo Electric Controls:

1. Photo Electric Controls by Tork, Intermatic and Paragon equal to those indicated below and approved by the engineer will be acceptable.
2. Photo Electric Controls (Photo switches; Photo cells) shall be Intermatic #K4133 rated at 3000W, 277 volts, or #K4121 rated at 1800W, 120 volts, weatherproof. Mount on roof and orient photo electric controls to the north. Photo-electric controls supplied as a part of a fixture assembly shall be as provided by fixture manufacturer.

E. When a photo cell and time clock are specified for combination control, they shall be connected in series. The time clock to be on during the day, the photo cell will turn the lights on during the day if a storm passes over and at dusk. Set the time clock to turn the lights off in the evening and back on before sunrise per the Governments requirements. At sunrise, the photo cell will turn the light off.

2.4 EMERGENCY LIGHTING AND POWER:

A. When emergency battery power packs are optional to the specified exit signs and emergency fixtures and are not included in the model number in the light fixture schedule, the emergency battery power packs shall be included as part of the specified fixture when they are not connected to an emergency generator system. Verify on drawings.

B. Emergency operation of fluorescent fixtures:

1. Fluorescent fixtures shown in the fixture schedule or lighting plans as an emergency fixture shall be supplied with a factory installed sealed replaceable nickel cadmium battery and a solid state inverter charger and switch systems.
2. Other lamps not on emergency system in same fixture will be switched with area lights. Lamp sockets in emergency fluorescent fixtures shall be in the exact same position as lamp sockets in non-emergency fixtures of the same type and number of lamps. All components shall be contained within the fixture. The emergency battery system shall operate two lamp (1100 lumen minimum) for a minimum of 90 minutes. Battery charger shall be capable of recharging batteries to full charge within 24 hours after complete discharge. Fixture shall contain pilot light to indicate charger condition and a test switch to simulate power failure. Systems shall be unconditionally guaranteed for three (3) years by the factory. Unit to be Underwriters Laboratory listed and labeled as an emergency unit. Units shall be manufactured by Bodine, Universal or approved by engineer.

C. Exit Signs And Other Emergency Fixtures:

1. Provide emergency battery power packs on all exit signs and emergency fixtures that are not connected to an emergency generator.
2. Batteries shall be lead calcium, pure lead, or nickel cadmium. Lead acid will not be accepted. Batteries shall be unconditionally guaranteed for 5 years with a 10 year prorated warranty from the factory. Units shall be Underwriter's Laboratory listed and labeled as an emergency unit. Batteries shall be provided as standard or as optional equipment of the same series of the specified fixtures.
3. The emergency Battery Section shall be connected on the same circuit as the light ahead of any switches or contactors controlling area lights so that emergency lighting is maintained at all times.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, and as shown on the drawings.
- B. Align, mount and level the lighting fixtures uniformly.

- C. Avoid interference with and provide clearance for equipment. Where the indicated locations for the lighting fixtures conflict with the locations for equipment, change the locations for the lighting fixtures by the minimum distances necessary as approved by the engineer.
- D. For suspended lighting fixtures, the mounting heights shall provide the clearances between the bottoms of the fixtures and the finished floors as shown on the drawings. Verify all heights with the architect prior to mounting.
- E. Lighting Fixture Supports:
 - 1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Shall maintain the fixture positions after cleaning and relamping.
 - 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
 - 4. Hardware for recessed fluorescent fixtures:
 - a. Where the suspended ceiling system is supported at the four corners of the fixture opening, hardware devices shall clamp the fixture to the ceiling system structural members, or plaster frame at not less than four points in such a manner as to resist spreading of the support members and safely lock the fixture into the ceiling system.
 - b. Where the suspended ceiling system is not supported at the four corners of the fixture opening, hardware devices shall independently support the fixture from the building structure at four points.
 - c. In all cases, four NEC approved clips shall be installed to firmly attach the fixture to the ceiling.
 - 5. Hardware for surface mounting fluorescent fixtures to suspended ceilings:
 - a. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 1/4-inch secured to channel members attached to and spanning the tops of the ceiling structural grid members. Nonturning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.

- b. In addition to being secured to any required outlet box, fixtures shall be bolted to a plaster ceiling at four points spaced near the corners of each fixture. Prepositioned 1/4-inch studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 1/4-inch toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.
- F. Provide and install new lamps for each new lighting fixture installed and for each existing lighting fixture reinstalled.
- G. Contractor shall coordinate between the electrical and ceiling trades to ascertain approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed. Lay-in type fixture installed in sheet rock ceilings shall be provided with a flange and bolted to the ceiling.
- H. Connection to all fixtures mounted in lay-in ceilings shall be as follows: Provide J-Box supported from structure at 12" above fixtures for connections. Install UL listed 1/2" flexible conduit whip down to each fixture. Each whip shall be field cut to length to allow fixture to be relocated 4'-0" in any direction. Whips shall include 2 or 3 #12 Cu. THHN/THWN conductors (numbers as indicated) and a #12 ground. Fixtures supplied with UL listed whip shall be supplied with ground conductors. Tandem fluorescent fixtures shall have a factory supplied UL listed whip with conductors as required to interconnect fixtures. Length shall allow mounting fixtures 12'-0" on center in any direction.

END OF SECTION 16510

SECTION 16530 - SITE LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes the furnishing, installation, and connection of the exterior lighting.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT, GENERALLY:

- A. Material and equipment shall be in accordance with NEC, UL, ANSI, as shown on the drawings, and as specified.

2.2 FOUNDATIONS FOR POLES:

- A. Foundations shall be cast-in-place concrete.
- B. Concrete foundations shall be poured in forms. Forms shall be spirally wrapped treated paper for round foundations, and shall be constructed for square foundations. All concrete surfaces above grade shall be rub-finished with all edges rounded to approximately 1/4-inch radius.
 - 1. Concrete shall have 3000 psi minimum 28 day compressive strength.
 - 2. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on the drawings. Anchor bolts shall be in a welded cage or properly positioned by the tie wire to stirrups.
 - 3. Install copperclad steel ground rods, not less than 3/4-inch diameter by 10 feet long, at each foundation. For poles 30' and larger drive the rods vertically beside the foundations. Where rock or layered rock is present, drill a hole not less than two inches in diameter, backfill with tamped fine sand and drive the rod into the hole. Bond the rods to the poles with not less than No. 6 AWG bare copper wires. The method of bonding shall be approved for the purpose.
 - 4. Contractor shall remove all rock encountered to the full indicated depth of the pier without any additional cost to the Government. Verify conditions with soil borings.

2.3 POLES:

A. General:

1. Poles 60' and below shall be round tapered or as shown on the drawings, and as herein specified.
2. The pole and arm assembly shall be capable of supporting itself and the specified luminaire under wind forces of 110 mph with an additional 30 percent gust factor.
3. High mast poles shall be galvanized designed for 90 MPH winds with a 1.3 gust factor.

B. Types:

1. Square and Round Tapered Type Pole: Shall be of 6005-T5 wrought aluminum alloy (ANSI 135.1) or steel, not less than 0.125 inch wall thickness. Square poles shall be square in section, seamless, with outside dimensions of 4, 5, and 6 inches for maximum mounting heights of 15, 20 and 30 feet respectively. Finish shall be duranodic (or approved equal), or type as shown on the drawings. The pole shall include an appropriately sized hand hole and matching flush mounted cover, held in place by a captive flat head screw.
2. Provide a pole cap with finish to match the shaft, forming a neat water repellent closure.
3. Provide all poles with hand holes and a steel grounding stud opposite hand hole openings.

C. Base Assembly: Provide a base cover to conceal the mounting hardware and all pole-base welds. Square pole bases shall have a sleeve within the pole capable of supporting the pole before welding.

D. Bracket Arm(s): Shall be of 6063-T6 seamless tubing (ANSI H-35.1), of minimum 0.125 inch wall thickness, bolted to the pole by means of a steel plate welded to the arm.

E. Hardware: All necessary hardware shall be 300 series stainless steel.

2.4 LUMINARIES:

- A. Shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat and safe cleaning and relamping.
- B. Illuminating Engineering Society light distribution pattern types shall be as shown on the drawings.
- C. Incorporate ballasts in the luminaire housing except where otherwise shown on the drawings.
- D. Luminaries shall be sealed.
- E. Lenses shall be heat-resistant, borosilicate glass, prismatic refractors, or as specified on the drawings. Retain each refractor in a frame. Restrain the frame to the luminaire housing by hinges or chain.
- F. Lamp sockets for high intensity discharge (H.I.D.) fixture shall have locking type porcelain enclosures in conformance to the applicable requirements of ANSI C-81.
- G. Pre-wire internal components to terminal strips at the factory.
- H. Bracket mounted luminaries shall have leveling provisions and clamp type adjustable slip-fitters with locking screws.
- I. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.

2.5 HIGH INTENSITY DISCHARGE BALLASTS:

- A. For multiple voltage systems the ballasts shall be the high efficiency, copper wound, high power factor, constant wattage type, premium grade. Power factor shall not drop below 90% average over life of lamp.
 - 1. Design ballasts to operate the discharge lamp of the type and wattage shown on the drawings.
 - 2. Ballasts shall have individual overcurrent protection, as required by NEC and, as recommended by the ballast manufacturer.
 - 3. Ballasts shall be capable of providing reliable starting of the lamps at the lowest temperatures normally experienced at the construction site.

- B. Locate protective devices for ballasts, where required, to be accessible if the devices are not integral with ballasts.
- C. Each ballast shall operate not more than one lamp except where otherwise shown on the drawings.

2.6 DISCONNECTING DEVICES:

- A. Shall be watertight, submersible types suitable for the cables being installed and for use in outdoor lighting systems.

2.7 LAMPS:

- A. Install the proper lamps in every luminaire installed and every luminaire relocated or reinstalled.
- B. Lamps to be general-service, outdoor lighting types. High pressure sodium fixtures connected to standby power shall be twin tube standby type.

2.8 CIRCUITS: For circuits, see other sections of these specifications.

2.9 LIGHTING CONTROL EQUIPMENT: See Section 16510.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, and as shown on the drawings.
- B. Poles with Concrete Foundations:
 - 1. After the poles have been installed, and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 3/8-inch inside diameter, through the grout tight to the top of the concrete base for weeping.
- C. Site Lighting fixtures shall be field aimed. Manufacturers Representative shall be present for proper aiming after installation.

END OF SECTION 16530

SECTION 16620 - GENSETS AND ACCESSORY EQUIPMENT

PART 1 - GENERAL PROVISIONS

1.1 SCOPE:

- A. This specification covers requirements for providing a complete and operable electric generating system, including all devices and equipment specified herein, shown on the drawings, and/or as required for the service. Materials and equipment shall be new, and delivered to the site completely wired, tested, and ready for installation. Each system shall include the following:
1. Engine-generator set rated 275 kW and 330 KVA at .8 PF.
 2. Engine-generator control console resiliently mounted on each generating set shall include complete engine start-stop control and solid-state monitoring system.
 3. Manual transfer switches.
 4. Fuel filter, solenoid and pressure reducer.
 5. Mounted and loose accessories, control devices, and other equipment as specified herein and/or as shown on drawings.
 6. Such other components, accessories, parts, tests, documents, and services, as needed to meet the performance requirements of this specification.
- B. The equipment and services specified herein shall be provided by a single supplier who has been regularly engaged in the sales and service of engines, generators, generator sets, paralleling controls, transfer switches, and controls for a minimum of ten years. The emergency electric generating system described herein, including those components along with the engine auxiliaries shall be factory built, factory tested, and shipped by this single supplier, so there is one source of supply and responsibility for warranty, parts, and service. Supplier shall maintain a facility within 50 miles of jobsite.

- C. The responsibility for performance to this specification in its entirety cannot be split up among individual suppliers of components comprising the system, but must be assumed solely by the local authorized dealer of the generator set manufacturer. Specifically, note requirements for total system testing, equipment coordination and documentation.
- D. The system supplier shall provide literature and other information describing the equipment specified; data and other information shall be on the manufacturer's printed literature or letter head. Performance data shall be the result of test procedures in accordance with nationally recognized standards, in addition to such other procedures that are judged necessary by the manufacturer to insure maximum service reliability for emergency systems, and shall be available for inspection by the engineer upon request.
- E. APPROVED MANUFACTURERS ARE: Cummins, Caterpillar, Onan and Kohler.

1.2 TESTING:

The intent of this specification is to provide equipment of proven reliability and compatibility.

A. Factory Prototype Model Tests:

1. The power system consisting of prime mover, generator, and all necessary controls must be tested as complete systems on representative engineering prototype models, per the requirements of NFPA 110 for level 1 systems. A certificate certifying that this prototype testing has been accomplished, shall be submitted along with submittal data for approval.
2. Transient response and steady state governing, to demonstrate compliance with this specification.

B. Factory Production Model Tests:

1. Before shipment of the equipment to the jobsite, the generator set, and other system components shall be tested together under rated load and power factor for proper functioning at the generator set manufacturer's facility, including control and interfacing circuits per the requirements of NFPA 110. No exceptions to the requirements of this paragraph will be accepted.

2. Other Tests Shall Include:
 - a. Demonstration of compliance with NFPA 99 requirements for maximum demand load pickup and foreign and voltage stabilization within 10 seconds of loss of normal power.
 - b. Transient response and steady state governing, to demonstrate compliance with this specification.
 - c. Overload test: With generator set operating at rated speed, voltage and load, reduce speed to half rated by manually overriding the governor control. Generator set must recover to full speed with the rated load connected when the governor control is returned to its normal mode.
3. The engineer shall be notified in advance of these tests, and shall be able to witness these tests if he so chooses. Certified copies of test results shall be forwarded to the engineer for review, and approval before shipment of equipment to jobsite.

C. Field Tests After Installation:

1. The complete installation shall be initially started and checked out for operational compliance by factory trained representative(s) of the manufacturer of the generator sets, and the automatic transfer switches. The engine lubrication oil and antifreeze, as recommended by the manufacturer for operation under environmental conditions specified shall be provided by the supplier of the generator sets.
2. Upon completion of initial start-up and system checkout, the supplier of the generator sets shall perform a field test, with the engineer notified in advance, to demonstrate load carrying capability, stability, voltage and frequency response.
3. Simulated power failure test - generator sets shall be made ready for automatic operation and started by means of the test transfer switch(es) on the automatic transfer switch(es). Units shall run for the duration of all time delays and then automatically shut down.

1.3 WARRANTY:

- A. The complete standby electric power system, including engine-generator set, and transfer switches and shall be warranted for a period of five (5) years or fifteen hundred (1,500) operating hours, whichever occurs first, from the date of initial start-up. Warranty shall cover 100% of all parts and labor for the full warranty

period. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided with submittal documentation. In the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

1.4 LAYOUT AND DESIGN:

- A. The equipment spacing, mounts, electrical wiring, ventilation equipment, fuel, and exhaust components have all been sized and designed around a single manufacturer's equipment. The installing contractor shall be responsible for changes in the building work, made necessary from the installation of equipment other than specified, without additional cost to the Government. (Verify all work with the equipment manufacturer.)

1.5 CODES AND STANDARDS:

- A. The complete emergency power system, as installed, shall comply with all applicable local, state, and national standards. In particular, the equipment shall comply with the requirements of NFPA 99, and NFPA 110 for level 1 systems.

PART 2 - IMPLEMENTATION

2.1 INSTALLATION:

- A. Emergency electric generating system, along with transfer switches, annunciators, generator sets, and all components shall be installed, including all connections, at locations and as indicated on drawings, and wiring diagrams as specified herein, and in accordance with approved shop drawings, manufacturer's instructions, and manufacturer's standard specification and dimension sheets.

2.2 SUBMITTALS: The following information must be submitted for approval:

- A. Outline drawings of the equipment showing overall dimensions, power and control wiring entrance locations, breaker sizes and locations, lug sizes and locations, and front panel drawings showing all devices to be provided, with each device referenced to a material list with a complete description for the device.
- B. Interconnection detail drawing showing all control and power connections in the entire emergency system. Control connections between components are to be labeled with identical nomenclature.

- C. Literature describing in detail the equipment proposed, and all possible operating modes.
- D. A complete review of this specification, noting for each paragraph whether or not the proposed equipment complies with the project specifications, or deviates in some fashion. For each deviation, a justification for that deviation must be given.
- E. Complete test specification detailing the testing procedure to be used to verify the performance of the equipment provided.
- F. On the request of the project engineer, the manufacturer shall provide a complete set of operation manuals for the equipment proposed, at the time of the submittal for the engineer's review and approval.
- G. Submit voltage drop calculations.

2.3. INSTRUCTIONS, DRAWINGS, PARTS, AND OPERATION INFORMATION:

- A. Two copies of complete instructions shall be supplied to Government prior to final acceptance. Material shall be in booklet form and shall consist of operating and maintenance manuals, parts manuals, dimensional drawings, wiring diagrams and schematics, interconnection wiring diagrams, and necessary information for proper operation, service, and maintenance of the equipment and major components supplied.

2.4 GOVERNMENT ORIENTATION:

- A. A representative of the supplier shall meet with a representative of the Government at the time of final acceptance tests and shall review the operation and parts books, correct starting and control methods, and recommend preventive maintenance procedures.

PART 3 - EQUIPMENT DESIGN REQUIREMENTS AND FEATURES

3.1 PERFORMANCE:

- :A. The generator set shall provide 275 kW and 330 KVA for an unlimited period of time under specified altitude and ambient conditions for all standby applications.
- B. The output of the generator set with specified governor and voltage regulator shall meet the following requirements:
 - 1. Random frequency variation will not exceed +/-0.5 percent (+/-0.3Hz) of it's mean value for constant loads, no load to full load.

2. Random voltage variation will not exceed +/-0.5% of it's for constant loads, from no load to full load.
3. Frequency regulation under varying loads from no load to full load shall be isochronous.
4. Voltage regulation under varying loads from no load to full load shall not exceed +/-1.0%.
5. On application of maximum demand kW and KVA step as described below, unit shall recover to stable operation and rated conditions within 10 seconds. Maximum voltage dip under these conditions shall not exceed 20%.
6. Manufacturers of Generators shall submit calculations with marked data indicating generators will start the following items and still maintain voltage as identified above. Manufacturers shall increase kW rating of their unit if required by loads. Sizing shall be at the system voltage.
 - a) 35 KVA Lts. Misc. Equipment.
 - b) 52 Hp of Misc. Motors - 5 HP max.
 - c) (1) 20 HP Type "H" code motor.
 - d) Only 1 motor will start at a time, max. load start 2nd motor with 1st motor running and remaining loads on.

In the event approved manufacturers require larger kW generator sizes than specified to meet loading requirements as listed above, the electrical contractor shall include in his bid the amount required to increase feeder, transfer switch, main switchboard switch, distribution panel sizes, etc., as required for the increased kW size of the generator to be provided. This amount shall be established in his bid prior to bid date. These changes shall be made with no increased cost to the Government after the bid date. The electrical contractor shall submit with the generator shop drawings new feeder, switch, and panel sizes for approval by the engineer. The generator shop drawings shall be submitted prior to shop drawing submittal of the service and distribution equipment and any changes required to the equipment because of increased generator sizes shall be reflected on the equipment shop drawings prior to submittal to the engineer.

3.2 ENGINE-GENERATOR SET DESIGN:

- A. General: Each generator-set shall be mounted on suitable welded steel base to maintain proper alignment between components.
- B. Engine:
 - 1. Engine shall be stationary, liquid-cooled, natural gas. Design shall be two or four cycle. Engine shall be certified by manufacturer as capable of driving a generator of kW rating as specified herein, for an unlimited period of time, in a standby application.
 - 2. Engine shall be capable of driving the generator of this rating for ambient conditions of 110 degrees F 29.92 inches Hg (101 Kpa) barometric pressure, and 1000 ft. elevation.
 - 3. Arranged for direct connection to the alternating current generator.
- C. Engine equipment shall include:
 - 1. Remote two-wire, negative ground, 24 V.D.C. starting system. Provide electric starter, with two independent systems to disconnect the starting circuit upon engine starting.
 - 2. Positive displacement, mechanical, full pressure lubrication oil pump with pressure regulation valve, full flow oil filters with replaceable elements, integral oil cooler, dipstick oil level indicator, oil drain valve with hose extension.
 - 3. Primary and secondary fuel filters with replaceable elements, automatic shutoff, all mounted on the engine. Replaceable dry element air cleaner.
 - 4. Provide all electronic, isochronous governor for isochronous frequency regulation, proper interface to paralleling equipment controls. Frequency shall be regulated within .5% of any constant load condition from 0 to 100% of rated load.
 - 5. Necessary protective devices and engine gauges shall have sensing elements located on the engine to interface with the generator set control; as specified under "Engine-Generator Control" herein.

6. 35 Amp battery charging alternator with transistorized voltage regulator.
7. Engine mounted, tank-type, engine coolant heaters, single-phase, 208 VAC, 4000 watts, shall be provided for each engine. Contractor shall provide proper branch circuit from normal utility power source.
8. 120VAC oil sump heaters per engine or circulation pumps. Contractor shall provide proper branch circuit from normal utility power source
9. Engine protective devices shall include overcranking protection, low oil pressure, high coolant temperature, and overspeed shutdown.

3.4 ENGINE COOLING SYSTEMS:

- A. Engine shall be radiator cooled by a skid mounted radiator system. Genset cooling system shall be designed to allow operation of the genset at rated load in a 122 degree F ambient at site elevation.
- B. Provide 50% ethylene glycol antifreeze solution to fill entire cooling system.
- C. The system shall include, unit mounted radiator, blower fan, water pump, thermostat and radiator duct fan.

3.5 ENGINE EXHAUST SYSTEM:

- A. Exhaust silencer shall be provided for each engine of size as recommended by manufacturer. Silencer shall be chambered construction of the critical type. Contractor shall mount silencer so its weight is not supported by the engine. Silencer shall be mounted as close as is practical to the engine.
- B. Flexible seamless stainless steel exhaust connection shall be provided as required for connection between engine exhaust manifold and exhaust line (24" minimum).
- C. Provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from entering the engine.
- D. Provide all necessary flanges and special fittings, etc. for proper installation.
- E. Contractor shall mount and install all exhaust components as shown on drawings and as required for code compliance. All components shall be properly sized to assure proper operation without excessive back pressure when installed as shown on drawings.
- F. Make provisions as required for pipe expansion and contraction.

- G. Contractor shall cover exhaust silencer and all indoor exhaust piping with a proper insulating material in a manner not to interfere with flexible exhaust connections.
- H. Thickness and type of insulation shall be shown on mechanical drawings.

3.6 ENGINE FUEL SYSTEMS:

- A. The manufacturer of the genset shall provide and warrant the complete engine fuel system. Provide all required items including, flexible fuel connector, fuel filter, and pressure reducer.

3.7 GENERATOR:

- A. Generator shall be single-bearing, drip-proof construction, synchronous type, revolving field, with direct drive centrifugal blower for cooling and minimum noise. Stator shall be skewed design and twice impregnated with high-temperature polyester varnish. Insulation shall be Class F or Class H per NEMA MG1.65 and BS 2757. Generator shall be directly connected to engine flywheel housing. Rotor shall be driven through a flexible coupling to insure permanent alignment. The maximum temperature rise at rated load shall not exceed 80 degrees C at 40 degrees C ambient (for Class F insulation) or 105 degrees C (for Class H insulation). The maximum subtransient reactance of the generator shall not exceed 13%. Generator design shall prevent potentially damaging shaft currents.
- B. Voltage regulator:
 - 1. Regulator shall be three phase sensing, solid-state temperature compensated design and shall function by controlling the exciter magnetic field between stator and rotor. The voltage regulation system shall be insensitive to severe, load induced waveshape distortion from SCR or thyristor circuits such as those used in battery charging (UPS) and motor speed control equipment loads. Voltage regulator shall be mounted in the genset control panel.
 - 2. Voltage regulation system shall include overvoltage protection to protect the system against voltage regulator failure or loss of reference, and to protect the system loads from damaging overvoltage conditions.
 - 3. Voltage regulation system shall include permanent magnet exciter, to provide 250% of rated current for 10 seconds without damage to generator. After 10 seconds the generator field shall collapse to protect genset to switchgear power connections.
 - 4. Voltage regulation system shall also be provided with loss of field monitor (or reverse VAR protection) and KVAR control, which may be mounted in the paralleling switchgear at the discretion of the supplier.

- C. The alternator, exciter, and voltage regulator shall be designed and manufactured by the generator set manufacturer so that the characteristics shall be matched to the torque curve of the prime mover. System shall provide automatic voltage reduction if the load demand exceeds the engine capacity to prevent engine stalling and saturation of magnetic components.
- D. Generator set shall be capable of safe stable operation with SCR loads of up to 80% of the unit's KVA rating, without exceeding the temperature rise limits of the generator insulation system.

3.8 ENGINE-GENERATOR CONTROL:

- A. Provide a unit mounted control console that is factory built, wired, tested, and shock-mounted by the engine and generator manufacturer. Control console shall be mounted on the generator end of the set. Control wire shall have termination identification on each wire for ease of tracing. Control wires which run between generator set controls, and automatic load transfer controls shall have termination identification on both ends. Nameplates shall be provided to identify each device or function and shall be silk-screened white on a black background. The genset shall be capable of independent operation, without any control from remote equipment. Control panel shall meet NFPA 110.
- B. Engine-generator control shall include the following DC engine controls for each unit: run-stop-remote switch; remote start-stop terminals; lighted oil pressure gauge; lighted coolant temperature gauge; lighted battery charge rate ammeter; running time meter, AC voltmeter (dual range), AC ammeter (dual range) volt/Amp phase selector switch with off position, frequency meter 45-66 #2, voltage adjusting rheostat ($\pm 5\%$ range).
- C. All wiring for connection to remote devices shall be wired to properly numbered and labeled terminal blocks. Contractor shall install stranded wires to all remote devices.
- D. Provide cycle cranking system as recommended by engine manufacturer and cranking limiter with 75 second cranking cycle with lockout.
- E. Provide solid-state voltage regulator as described previously.

- F. Generator set monitoring system shall include solid-state engine monitor with individual lights and one common external alarm contact, indicating each of the following conditions for each unit: run (green light); overcrank shutdown (red light); overspeed shutdown (red light); high coolant temperature shutdown (red light); low oil pressure shutdown (red light); high coolant temperature pre-alarm (yellow light), low oil pressure pre-alarm (yellow light); low fuel (yellow light); low coolant temperature (red light); switch OFF (flashing red light - indicates generator set not in automatic mode); low fuel; loss of field (red); high battery volts (red light); low battery volts (red light); low fuel (red light); and over/under voltage (red). Monitoring system shall include lamp test switch and reset switch for manual reset of tripped condition.
- G. Provide one set of "form C" N.O./N.C. contacts to signal operation whenever the genset is running, and 1 set to open ventilation dampers.
- H. Provide lubricating oil temperature gauge.
- I. Provide low coolant level alarm and shutdown, which shall activate high engine temperature shutdown lamp and alarm.

3.9 AUXILIARY EQUIPMENT AND ACCESSORIES:

- A. Starting Batteries: A heavy-duty, diesel starting, lead-acid battery set shall be provided for each engine and shall be mounted on a battery rack furnished with the generator set. Provide all intercell and connecting battery cables.
- B. Battery Chargers:
 - 1. Provide an SCR voltage regulated battery charger for each genset in the system. Battery charger shall be rated 10 amps minimum.
 - 2. Battery charger shall include the following features:
 - a. DC Voltmeter and Ammeter, 2% accuracy
 - b. On/Off Switch
 - c. 12 Hour Equalize Timer Control Switch
 - d. Alarm Indication Lamps and Dry Contacts to indicate the following conditions: Loss of AC Power, Low Battery Voltage, High Battery Voltage, and Power On.
 - e. Fuse protection of both the power transformer and bridge rectifier.

3. Charger design shall allow charging current to taper to zero amperage when batteries are fully charged.
- C. Provide spring vibration isolators. Number and size as required by total system. Springs shall be near mid-point in field after complete installation.
- D. Each generator shall have an concrete isolation pad with raised portion under skids per the detail on the drawings. Exact size, depth, and steel arrangements shall be verified with the structural engineer after the generator shop drawings are approved.
- E. Main Unit Circuit breakers at the generator. Sized per the drawings.
- F. Provide all - weather lockable enclosure to protect the generator system. Install day tank between the skids within the enclosure. Exhaust silencer shall be mounted on top of the enclosure. Verify generator orientation and exhaust direction in the field so as to not discharge exhaust in a direction that it will be brought into the building by HVAC air intakes. Make all required modifications to the exhaust in the field.

3.10 CAUTION SIGN:

- A. Electrical contractor shall provide and install an 8" x 11" white enamel finish on 20 gage steel panel (minimum size) secured to the housing of the generator with 3/4" high stenciled red letters: "CAUTION". This Plant Starts Automatically. It May Start At Any Time." Letters shall be neat and legible. Panel shall be visible to anyone approaching the generator plant.
- B. Install nameplate on 'ATS' and labeled as follows: "This building is provided with a standby emergency generator located adjacent to main service transformer." Nameplate shall be the same size and type as required for switchboards except that front and back shall be red with white core.

3.11 LABELING AND PAINTING:

- A. Label the disconnect switch feeding the emergency system. "Emergency Power Disconnect Emergency Generator is Connected to this Feeder".

END OF SECTION 16620

SECTION 16670 - LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes the layout, furnishing and installation of a complete U. L. master labeled and L.P.I. certified lightning protection system complying with UL 96, UL 96A and NFPA 780 and L.P.I. 175.
- B. Provide and install all points, point bases, conductors, lugs, cable hold downs, thru-roof assemblies, ground rods, etc. As required for a complete and operational installation. The layout shall be done by a member of the Lightning Protection Institute. Coordinate design and installation with the architectural, mechanical and structural drawings. Verify the types of roofing materials.

1.2 SUBMITTALS:

- A. Shop Drawings:
 - 1. Submit Complete design and layout drawings including isometric and plan views showing layout and connections to the required metal surfaces.
 - 2. Show the methods of mounting the system to the adjacent construction and to the specific roofing materials on this project.
- B. Qualifications: Submit proof that the installer of the lightning protection system has had suitable and adequate experience installing other lightning protection systems, and is capable of installing the system as recommended by the manufacturer of the equipment.
- C. Certification: Two weeks prior to final inspection, deliver to the engineer four copies of the certification that the installed lightning protection system has been inspected by a UL representative and has been approved by UL without variation.

1.3 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification. The publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):
 - 70-84 National Electrical Code (NEC Amendments 84-1 thru 84-2)
 - 780-1995 Lightning Protection Code

- C. Underwriters Laboratories, Inc. (UL):
 - 96-1995 Standard for Lightning Protection Components -9/4/85
 - 96A-1994 Installation Requirements for Lightning Protection Systems 10/5/83

1.4 APPROVED SUPPLIER:

- A. A-C Lightning Security, Inc., P.O. Box 219, Maryville, MO. - 64468, Ph. 1-800-821-5575 - Fax 1-816-562-2932.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Attach master labels "A" or "B" to each item by its manufacturer as evidence that the materials have been manufactured in conformance with the UL Standards for master label lightning protection materials.
- B. In addition to conformance to UL 96, the component material requirements are as follows:
 - 1. Conductors: Electrical grade copper.
 - 2. Air terminals: Solid copper, not less than 3/8-inch diameter, with sharp points.
 - 3. Ground rods: Copperclad steel, not less than 3/4-inch diameter by 10 feet long.
 - 4. Ground plates: Solid copper, not less than 1/16-inch thick.
 - 5. Tubing: Stiff copper or brass.
- C. Anchors and fasteners: Bolt type which are most suitable for the specific anchor and fastener installations.
- D. Use aluminum components, only if necessary to maintain compatibility with aluminum roofing systems. Otherwise copper components are required.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install the conductors as inconspicuously as practical and with the proper bends.
- B. Install the vertical conductors within the concealed cavity of exterior walls. Run the conductors to the exterior at elevations below the finished grade and make the ground connections to the earth outside of the building or stack perimeter.
- C. Make connections of dissimilar metal with bimetallic type fittings to prevent electrolytic action.
- D. Use the exothermic welding type connections which form solid metal joints in the main vertical and horizontal conductors, and for connections that are not exposed in the finish work.
- E. For exposed cable downloads, protect copper conductors with stiff copper or brass tubing, which enclose the conductors from the top to the bottom of the tubing, between one foot below and six feet above the finished grade.
- F. For the earth connections, install ground rods and ground plates, and the conductor connections to them and the main water pipes in the presence of the engineer. For the conductors located outside of the building or stack, install the conductors not less than two feet below the finished grade.
- G. For structural steel buildings, connect the steel framework of the buildings to the main water pipe near the water system entrance to the building.
- H. Connect exterior metal surfaces, located within three feet of the lightning protection system conductors, to the lightning protection system conductors to prevent flashovers.
- I. Grounding: Test the ground resistance to earth by standard methods and conform to the ground resistance requirements specified in Section, GROUNDING.
- J. Where shown, use the structural steel framework or reinforcing steel as the main conductor:
 - 1. Weld or bond the non-electrically-continuous sections together and make them electrically-continuous.

2. Verify the electrical continuity by measuring the ground resistance's to earth at the ground level, at the top of the building or stack, and at intermediate points with a sensitive ohmmeter. Compare the resistance readings.
 3. Connect the air terminals together with an exterior conductor connected to the structural steel framework at not more than 100 foot intervals or tie each air terminal directly to roof steel and delete perimeter roof cable.
 4. Install ground connections to earth at not more than 60 foot intervals around the perimeter of the building.
 5. Weld or braze bonding plates, not less than eight inches square, to cleaned sections of the steel and connect the conductors to the plates or exothermic weld such as caldweld, thermoweld, etc.
 6. Do not pierce the structural steel in any manner. Connections to the structural steel shall conform to the UL Publication No. 96A.
- L. When the lightning protection systems have been installed, have the systems inspected and tested by a UL representative. Obtain and install a UL numbered master level "C" for each of the lightning protection systems at the location directed by the UL representative and the engineer. Also, provide Lightning Protection Institute (L.P.I.) 175 required on-site Quality control Inspections and Reports to Architect/Engineer and Final L.P.I. Certification documents upon project completion.

END OF SECTION 16670

SECTION 16690 - CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)

PART 1 - GENERAL REQUIREMENTS

- 1.1 The contractor shall obtain the services of a corrosion engineer to design, supervise and inspect the installation of the cathodic protection system. Corrosion engineer refers to a person, who, by reason of his knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control on buried or submerged metallic piping systems and metallic tanks. Such person may be a licensed professional engineer or may be a person certified as being qualified by the National Association of Corrosion engineers if such licensing or certification includes suitable experience in corrosion control on buried or submerged metallic piping systems and metallic tanks. The corrosion engineer shall submit his design of the system to the Contracting Officer with the shop drawing submittal for approval by the Contracting Officer.
- 1.2 Evidence of qualifications of the corrosion engineer shall be submitted by the contractor.
- 1.3 The corrosion engineer shall insure that the cathodic protection system is installed, tested, and placed into service in accordance with the requirements specified.
- 1.4 The installation shall conform to the applicable rules of NFPA 70.

PART 2 - PRODUCTS

- 2.1 Magnesium anodes shall be Type III corresponding to the applicable chemical composition listed in the following table:

PERCENT BY WEIGHT				
ELEMENT	TYPE I	TYPE II	TYPE III	MG-MN ALLOY
Aluminum	5.0 - 7.0	5.3 - 6.7	5.3 - 6.7	0.010 Max.
Zinc	2.0 - 4.0	2.5 - 3.5	2.5 - 3.5	
Manganese	0.15 Min.	0.15 Min.	0.15 Min.	0.50 - 1.30
Copper	0.1 Max.	0.05 Max.	0.02 Max.	0.02 Max.
Silicon	0.30 Max.	0.30 Max.	0.10 Max.	
Iron	0.003 Max.	0.003 Max.	0.003 Max.	0.03 Max.
Nickel	0.003 Max.	0.003 Max.	0.002 Max.	0.001 Max.
Others	0.30 Max.	0.30 Max.	0.30 Max.	0.05 each or 0.30 Max. Total
Magnesium	Balance	Balance	Balance	Balance

- 2.2 Connecting Wire shall be No. 12 AWG solid copper wire, not less than 10 feet long, unspliced, complying with NFPA 70, Type TW insulation. Connecting wires for magnesium anodes shall be factory installed with the place of emergence from the anode in a cavity sealed flush with a dielectric sealing compound.
- 2.3 Anodes shall be factory packaged with an artificial backfill in a water permeable fabric sack or cardboard container. Anodes shall be packaged on a vibrating platform to attain dense packing, and centering shall be assured by means of spacers.
- 2.4 Artificial backfill shall have the following composition:

Material	Approx. Percent by Weight
Gypsum	75
Bentonite	20
Sodium Sulfate	5
Total	100

2.5 MISCELLANEOUS MATERIALS:

- A. Electrical Wire shall be stranded copper wire with NFPA 70, Type RHW-USE insulation. Connecting wire splicing shall be copper compression connections made for the purpose or exothermic welds following instructions of the manufacturer. Split-bolt connections shall not be used.
- B. Rigid galvanized steel conduit and non-metallic conduit shall conform to Section 16050 of this Specification.
- C. Test Boxes and Junctions Boxes shall be outdoor type conforming to UL 514.
- D. Sealing and dielectric compound shall be a black, rubber based compound that is soft, permanently pliable, tacky, moldable, and unbacked. Compound shall be applied as recommended by the manufacturer, but not less than 1/2-inch thick.
- E. Coating compound shall be either cold-applied coal-tar base mastic, hot-applied coal-tar enamel or an approved pipeline wrapping.
- F. Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.
- G. Sheaths for encapsulating electrical wire splices to be buried underground shall fit the insulated wires entering the spliced joint.

- H. Compound for encapsulating electrical wire splices to be buried underground shall be a two package system made for the purpose.
- I. Test stations shall be complete with an insulated terminal block having the indicated number of terminals and shall be provided with a lockable cover and have a cast-in legend, "C.P. Test".

PART 3 - INSTALLATION

- 3.1 Unless otherwise indicated, all equipment shall be installed in accordance with the manufacturer's recommendations. All underground metallic water, gas, sprinkler and other piping, etc. shall be provided with cathodic protection.
- 3.2 Anodes of the size required shall be installed at the locations shown on shop drawing submittal plans. Locations may be changed to clear obstructions if approved. Anodes shall be installed as indicated in a dry condition after any plastic or waterproof protective covering has been completely removed from the water permeable, permanent container housing the anode metal. The anode connecting wire shall not be used for lowering the anode into the hole. The annular space around the anode shall be backfilled with fine earth in 6-inch layers and each layer shall be hand tamped. Care must be exercised not to strike the anode or connecting wire with the tamper. Approximately 5 gallons of water shall be applied to each filled hole after anode backfilling and tamping has been completed to a point about 6 inches above the anode. After the water has been absorbed by the earth, backfilling shall be completed to the ground surface level.
- 3.3 Single anodes spaced as shown shall be connected through a test station to the pipeline, allowing adequate slack in the connecting wire to compensate for movement during backfill operation.
- 3.4 Groups of anodes in quantity and location shown shall be connected to a collector cable. The collector cable shall make contact with the structure to be protected only through a test station.
- 3.5 Resistance wires shall not be used to reduce the current output of individual or group anodes.
- 3.6 Connections to ferrous pipe and metal tanks shall be made by exothermic weld methods manufactured for the type of pipe and tank.
- 3.7 Electric arc welded connections and other types of welded connections to ferrous pipe and structures shall be approved before use.

3.8 TEST STATIONS:

- A. Test stations shall be of the type and location as shown on the shop drawing submittal plans and shall be curb box post mounted. Buried electrically insulating joints shall be provided with test wire connections brought to a test station. Unless otherwise shown, other test stations shall be located as follows:
- B. At 1,000-foot intervals or less.
- C. Where the pipe or conduit crosses any other metal pipe.
- D. At both ends of casings under roadways and railways.
- E. Where both sides of an insulating joint are not accessible above ground for testing purposes.

3.9 CRITERIA OF PROTECTION:

- A. Criteria for determining the adequacy of protection on a buried pipe and tank shall be in accordance with NACE RP-01 and shall be selected by the corrosion engineer as applicable.
- B. Iron and Steel:
 - 1. One of the following methods shall apply:
 - 2. A negative voltage of at least minus 0.85 volt as measured between the pipe or tank and a saturated copper-copper sulfate reference electrode contacting the earth directly over the pipe. Determination of this voltage shall be made with the cathodic system in operation.
 - 3. A negative voltage shift of at least 300 millivolts as measured between the pipe and a saturated copper-copper sulfate reference electrode contacting the earth directly over the pipe or tank. Determination of this voltage shift shall be made with the protective current applied. These criteria apply to pipes not in electrical contact with dissimilar metals.
 - 4. A minimum polarization voltage shift of 100 millivolts as measured between the pipe and a saturated copper-copper sulfate reference electrode contacting the earth directly over the pipe. This polarization voltage shift shall be determined by interrupting the protective current and measuring the polarization decay. When the protective current is interrupted, an immediate voltage shift will occur. The voltage reading, after the immediate shift, shall be used as the base reading from which to measure polarization decay.

5. A minimum negative voltage shift of 150 millivolts produced by the application of protective current. The voltage shift shall be measured between the pipe and a saturated copper-copper sulfate reference electrode contacting the earth directly over the pipe.
- 6 A minimum negative polarization voltage shift of 100 millivolts measured between the pipe and a saturated copper-copper sulfate reference electrode contacting the earth, directly over the pipe. The polarization voltage shift shall be determined as outlined for iron and steel.

3.10 TESTS AND MEASUREMENTS:

- A. After backfill of the pipe and anodes is completed, but before the anodes are connected to the pipe, the static potential-to-soil of the pipe shall be measured. The locations of these measurements shall be identical to the locations specified for pipe-to-reference electrode potential measurements. The initial measurements shall be recorded.
- B. Before the anode system is connected to the pipe, an insulation test shall be made at each insulating joint or fitting. This test shall demonstrate that no metallic contact, or short circuit exists between the two insulated sections of the pipe. Any insulating fittings installed and found to be defective shall be reported to the Contracting Officer.
- C. As the anodes or groups of anodes are connected to the pipe, current output shall be measured with an approved low resistance ammeter. The values obtained and the date, time, and location shall be recorded.
- D. Upon completion of the installation and with the entire cathodic protection system in operation, electrode potential measurements shall be made using a copper-copper sulfate reference electrode and a potentiometer-voltmeter, or a direct current voltmeter having an internal resistance (sensitivity) of not less than 100,000 ohms per volt and a full scale of 1 or 2 volts. The locations of these measurements shall be identical to the locations used for the baseline potentials. The values obtained and the date, time, and locations of measurements shall be recorded.
- E. Location of Measurements:
 1. For coated piping or conduit, measurements shall be taken from the reference electrode located in contact with the earth, directly over the pipe. Connection to the pipe shall be made at service risers, valves, test leads, or by other means suitable for test purposes. Measurements shall be made at intervals not exceeding 400 feet. In no case shall less than three measurements be made over any length of line. Additional measurements shall be made at each distribution service riser, with the reference electrode placed directly over the service line.

- 3.11 Before final acceptance of the installation, the electrical separation of carrier pipe from casings shall be tested and any short circuits corrected.
- 3.12 Before final acceptance of the installation, interference tests shall be made with respect to any foreign pipes in cooperation with the Government of the foreign pipes. A full report of the tests giving all details shall be made.
- 3.13 All pipe-to-soil potential measurements including initial potentials where required shall be recorded. Contractor shall locate, correct and report to Contracting Officer any short circuits to foreign pipes encountered during checkout of the installed cathodic protection system. Pipe-to-soil potential measurements are required on as many pipes as necessary to determine the extent of protection or to locate short-circuits.

END OF SECTION 16690

SECTION 16741- SITE TELECOMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope: Extent of telephone system work is indicated by drawings and details, and is hereby defined to include, but not by way of limitation, telephone wiring/cabling, terminals, connecting blocks, data wiring/cabling, telephone/data outlets and other associated equipment and hardware.
- B. Related Sections: Refer to other Division 16 sections for the following:
 - 1. Basic Methods and Requirements - Section 16050
 - 2. Fire Stop - Section 16110-3B & C
 - 3. Underground Electrical Construction - Section 16119
- C. Provide submittals on all products specified with this section.

1.2. QUALITY ASSURANCE

- A. Installers Qualifications: Firms with at least 5 years successful installation experience with projects utilizing telephone and data systems and wiring similar to that required for this project. To ensure data distribution system is Category 5 certified, installer must be a Building Industry Consulting Service International (BICSI) member.
- B. Codes and Standards:

The standards, specifications and codes listed are the basis of the state Premise Distribution System standards and shall be used to provide base guidelines for this project. Any applicable code, guideline or specification that requires a higher degree of safety or performance shall take precedence over a more lenient requirement whether stated here or not.

Conform to the following:

1. National Electrical Code (NEC): comply with applicable local code requirements of the authority having jurisdiction and NEC, including 725, 770, 800, 820 and OFNR Series articles as applicable to installation and construction of telephone and data systems.
2. Federal Communications Commission (FCC): Comply with part 68 and Subpart J of part 15, Federal Communications Commission Rules, pertaining to telephone equipment and Class A computer registration by manufacturer.
3. Institute of Electrical and Electronics Engineers (IEEE): Comply with Std 241 and 802, IEEE Recommended Practice for electric Power Systems in Commercial Buildings: pertaining to communication systems and Local Area Networks.
4. National Electrical Manufacturers Association (NEMA): Comply with NEMA's Pub No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."
5. Rural Electrification Administration (REA): Comply with Rural Electrification Administration specifications pertaining to construction and installation of telephone cabling.
6. Electronic Industries Association (EIA): Comply with EIA Standards RS-453, 455, 464 and EIA/TIA (Telecommunications Industries Association) Standards 568, 569, 570, 606, 607 and Technical Systems Bulletin 36,40, and 53 of the Commercial Building Telecommunication Wiring Standards pertaining to categorizing and installation of telephone and data systems.
7. Underwriters Laboratories (UL): Comply with, specifically, subjects 444 and 13 (STP) as referenced UL ratings and/or classifications as mentioned in the above standards.
8. Building Industry Consulting Service International (BICSI): Comply with telecommunication industry's recognized standards as published in the Telecommunications Distribution Methods Manual pertaining to the installation practice of voice and data systems.
9. OSHA

1.3. DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver telephone equipment and components in factory-fabricated containers or wrappings, which properly protect equipment from damage.
- B. Storage: Store telephone equipment and components in original packaging. Store inside in a well-ventilated space protected from weather, moisture, soiling, humidity, and extreme temperatures.
- C. Handling Handle telephone equipment and components carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.4. COORDINATING AND SEQUENCING

- A. Coordinating: Coordinate with other electrical work and mechanical work to include wires/cables, electrical boxes and fittings, duct work, and raceways, to properly interface installation of telephone system with other work.
- B. Sequencing: Sequence installation of telephone system with other work to minimize possibility of damage and soiling during remainder of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Telephone/Data/Video Cable and Cable Connectors: Provide copper Telephone/Data/Video cable, and cable connectors, except where video coaxial and Fiber is specified, in sizes and types indicated, and as recommended by telephone equipment manufacturer for indicated safety and applications. Mate and match connector materials to factory-installed equipment connectors.

1. Cable (Horizontal-Underground):

- a. VOICE Telephone Exchange Cable. Solid, annealed, 24 or 26 AWG solid copper conductors. Polyethylene or polypropylene conductor insulation color coded to telephone industry standards. Insulated conductors are twisted into pairs of varying lengths of lay to minimize cross-talk. Pairs are stranded into units and the resultant cable core is covered with a non-hygroscopic tape.

The cable sheath consists of a 0.008 inch corrugated, co-polymer coated aluminum shield and a black polyethylene jacket. The jacket is sequentially printed with a footage marker at regular intervals. Meets or exceeds the EIA/TIA 568 Commercial Building Wiring Standard.

- b. LAN/DATA (Fiber Optic) Composite Non-Metallic Fiber Optic Campus Backbone Cable has a core consisting of multimode 62.5/125 μ m fibers and singlemode 9.3/125 μ m fibers. Fiber count as shown in following paragraphs per location. The fibers are separated into color-coded binder groups surrounded by polyethylene core tube. The core is covered by a nonmetallic crossply sheath that consists of fiberglass strength strands embedded in polyethylene. It must also comply with Bellcore, FDDI, EIA/TIA-568, and ICEA standards. Length as specified in drawings. Install each in 1, 1" interduct from termination point to termination point in buildings and pedestal. Continuous, length as required.

2. Cable (Horizontal-Indoor): Telephone & Data

- a. VOICE AT&T Category 3 telephone plenum cable. (4) twisted pairs of 24 gauge bare solid copper conductors insulated with ECTFE and twisted into pairs. The twisted pairs are assembled into a core and jacketed with WHITE plenum ECTFE. Underwriters Laboratories Listed Type MMP/CMP. Continuous, length as required. (AT&T Product Code 2010 004 AWH or equivalent with submittal approval).

- b. LAN/DATA AT&T Category 5 data plenum cable. 100 Ohm high performance cables composed of (4) twisted pairs of 24 gauge bare solid copper conductors insulated with Teflon and twisted into pairs. The twisted pairs are assembled into a core and jacketed with BLUE fluoropolymer. This cable to conform to the requirements specified in ICEA publication S-80 (Revision 10) - 576 that are applicable to pair inside wiring cable for plenum within a building. Underwriters Laboratories Listed Type CMP. Continuous, length as required..(AT&T Product Code 2061 004 ABL or equivalent with submittal approval).

3. Terminal Blocks:

- a. VOICE T 66 Block Connector System.

- (1) S66M Series Connecting Blocks: These are quick connect blocks used for field termination and interconnection made of a molded, self-extinguishing plastic block containing phosphor bronze tin-plated quick clips for making connections. 50 pair size recommended with two-prong clips used. RED clips for data if needed. These Blocks can be mounted on S89D Stand-Off brackets. (Siemon Company Part # S66M1-50 or equivalent with submittal approval)

- (2) Connecting Wires: CCW-F Hook-Up Wire to have solid annealed copper conductors individually insulated with PVC. The insulation is to be marked at regular intervals with additional code for color (White-Blue, Blue-White). CCW-F Hook-UP Wire is 24 AWG. containing 1 twisted pair. DC Resistance: 52 ohms/1000 feet. Mutual Capacitance: 0.015 μ F/1000 feet (maximum). Continuous length of cable as specified in details - must be long enough to reach the two farthest points of connecting blocks being connected plus an additional 12 inches on each end. This cable is to meet or exceed Category 3 requirements. (AT&T Product Code CCW-F 1/24 or equivalent with submittal approval)

- b. DATA - Fiber : The Siecor Fiber Distribution Cabinet - Wall mountable. 24 fiber capacity minimum. Panels for splicing and cross-connect are required. Submittal required for approval.

- (1) ST Connectors (Multimode & SingleMode) Loss: $\mu = 0.5\text{dB}$, $\sigma = 0.3\text{dB}$. Complete connection, concatenated statistics. 62.5/125 fiber for multimode and 9.3/125 for singlemode, 0.29 numeric aperture, ovality and concentricity equivalent to 1860A (AT&T) Cable. Dry connection. Fiber OD, nominal: 125 μm . Cable OD, nominal: 2.4 and 3.0 mm. Loss Repeat < 0.2dB per 200 reconnects. Materials: Tip, cap, and body - reinforced engineering plastic. Vendor Submittal required for approval.
- c. DATA - Copper: AT&T 110 Patch Panel System Terminal Blocks (Category 5). Must exceed the Category 5 requirements specified in EIA/TIA TSB_40. Made up of prewired 50-pair sizes and consist of 110 Wiring Blocks with direct field termination of building cables and special horizontal and vertical jumper troughs for arranging patch cords. Wiring Blocks and troughs are mounted on a metal back panel that has an express trough at the bottom.. (At&T or equivalent with submittal approval)
- (1) Patch Cords: 110 Patch Cords. All cords manufactured with AT&T data grade 1064 cordage. The round 1064 cordage consists of 4 pair 24 gauge tinned copper, stranded conductors insulated with high density polyethylene. The insulated conductors are tightly twisted into individual pairs and jacketed with BLUE flame retardant PVC. Must meet EIA/TIA TSB-36 Category 5 transmission requirements. Lengths shall be 9 feet. Provide and install quantity of 1600. (At&T or equivalent with submittal approval)

4. Outlets to consist of the following:

- a. Each jack shall be configured to accommodate up to two ports. If less than two ports are installed there shall be blanks or covers to install in the face plate. The finished design shall not allow openings in the face plate. The jack and two ports shall be sized to fit in a single gang box. One of the ports shall be category three, RJ-11, 6-pin, 110 style termination, or equivalent. One of the ports shall be category 5, RJ-45, 8-pin, 110 style termination. There shall be colored tabs or bezels with Icons or language that state or indicate DATA, or VOICE. Face plates shall be ivory or beige colored.

- (1) VOICE/DATA/LAN Connector: modular information outlet. Requiring one modular 6-position/6-conductor jacks and one modular 8-position/8-conductor jack. Insulation displacement adapters used. Must have one voice jack, label "VOICE", non keyed and, one LAN category 5 jack labeled "DATA". The wire insertion caps supplied shall be used to install the horizontal wire and should be left in place to provide protection from contamination and to secure the wire connections per Category 5 requirements for the LAN jack. (AT&T Product Code M11CH1 or equivalent with submittal approval)
- (2) Face Plate: DUPLEX face plate (AT&T Product Code M12A or equivalent with submittal approval).
- (3) VIDEO/Coaxial Wall Outlet: Smooth Finnish F-connector wall plates with one F-connector for use with RG6 Coaxial for CATV or other video applications. Quantity as needed. (AT&T COMCODE 105 414 783 or equivalent with submittal approval)

5. Telephone Accessories:

- a. Backboards: Supply and install in telephone closets shall be 3/4"x 8' x 4' plywood painted with 2 coats of high fire resistant, non conductive white paint.. Verify exact location with Engineer.
- b. Closures: Inline Splice Closure to consist of two reinforced plastic covers that fit over the cable end plates and are held together by snap-catch fasteners and reusable rubber seals. An alignment bar, sheath retention clamps, sealing washers, sealing tape and a bonding and grounding system to be included. Must pass both vertical and horizontal tests for flammability as specified in PUB 55006. Cylinder size and endplate types as required to terminate incoming service cable. Splice Closure provided in new Allied Health Science Building in earlier telecom phase. AT&T 2000 Series (Indoor) or equivalent with submittal approval.
- c. Protector Panel: AT&T 188 Multipair Building Entrance Protector Panel to provide service protection to 100 incoming service pairs per unit. Over-voltage and sneak current protection is mandatory. Will serve as a terminating field, consists of a metal housing containing mountings for 3B Gas Protector Units (AT&T Product Code 3B1-EW) One each per incoming service pair. The

input option is a 25 foot long, 26 AWG swivel cable stub with top or bottom feeds available and used as per indicated on drawings. Output option to include 66-Type connecting block. (AT&T Product Code 188B1-100 or equivalent with submittal approval)

- (1). Protector Unit, 3B-EW Series Individual. A wide-gap gas-tube arrester to provide over voltage protection for each incoming service pair. Unit to be molded of glass-reinforced, high heat distortion plastic. Line pins are to be gold plated and ground pins are to be solder plated. Two colors for circuit application; black for standard service and green for circuit not presently in use.
DC breakdown Voltage (at 2kV/sec): 265-424V.
Surge breakdown Voltage (at 100V/μsec):200-800V.
Insulation Resistance (PE-80): 100Mohms
DC Holdover Current (ANSI C62.31): 150V
Vented Breakdown Voltage(surpasses UL requirements):<1000V
DC Arc Voltage: 20 V
Glow-to-Arc Transition Current (ANSI C62.31): 0.5 A
Capacitance (PE-80): < 10 pF
AC Discharge (pe-80): > 65 A (11 cycles at 60 Hz)
Max. Impulse Discharge (PE-80):20kA (8 x 20μsec wave form)

6. Cable Supports: All cables above ceilings (Data, Voice & VIDEO) are to be supported by "D" Rings and/or J-Hooks.
 - a. J-Hooks: J-Hooks are to be steel with insulation material covering the hook and supported from structure above. J-Hook must be sized to support all cable plus 15% room for additional cable in the future.
 - b. "D" Rings: "D" rings are to be provided to support all voice and data cables in telephone communications rooms, 6" maximum centers with distribution rings Numbers 13A,B, and C. Size as required to support all cable plus 15% room for additional cable in the future.
 - c. Tie-Wraps: Thomas & Betts, TY-RAPS© brand. Will be plastic, heavy duty, and flame retardant (Must meet UL 94V-O flammability rating). Size as required. (Thomas & Betts Bulk Pkg. Cat. Number TY28MFR)

- d. Cable Labels: A quality grade general purpose vinyl-impregnated waterproof tape. Resistant to moderate amounts of oil, dirt, and temperature ranges from -30°F to 200°F. (Thomas & Betts, E-Z-Code© WBC vinyl cloth, standard Cat. No. WM-A-Z)
- 7. Tightening: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturers' torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A and B, and the National Electrical Code.

2.2 GROUNDING

- A. Provide for the installation of a common telecommunications ground that will extend from the building ground to the telecommunications spaces including the MDF. The contractor shall ensure that all aspects of telecommunications installations are ground in accordance with the NEC and EIA/TIA specifications.
 - 1. Provide #6 CU. equipment grounding connections for Data/Voice Wiring Blocks, patch panels, racks, metal troughs, protectors, etc. to grounding bus. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding. Horizontal cabling shall be grounded in compliance with ANSI/NFPA 70 requirements and practices, except where superseded by other authorities or codes. In addition to horizontal cables, these grounding requirements apply to all cross-connect frames, patch panel racks, active telecommunications equipment and test apparatus used for maintenance and testing.

2.3 ADJUSTING AND CLEANING

- A. Cleaning: Clean telephone equipment and components of dirt and construction debris upon completion of installation.
- B. Touch-up: Touch-up scratched or marred enclosure surfaces to match original finishes.
- C. Protection: Protect installed equipment and components from damage during remainder of construction period.

2.4. DEMONSTRATION / TESTING

- A. Minimum testing requirements for UTP is divided into the following conditions, keeping in mind that Attenuation and NEXT are the two most important factors and must be strictly adhered to by the installer. Record all tests and test results for all items specifically documenting the item tested and submit for engineers review.:
1. Open/Short Test.
 2. Polarity Test (reversals).
 3. Pair transpositions (crosses).
 4. DC loop resistance test: Loop resistance can be tested with a multimeter. Will be used to confirm distance as well as continuity. The DC resistance of all categories for this installation is 28.6 ohms per 1000 feet.
 5. Time Domain Reflectometer (TDR) test:..TDR is to be used to give the exact length where an impedance discontinuity is encountered (i.e., open circuit, short circuit, bridge tap, mismatch, etc.).
 6. Attenuation/crosstalk analyzer test:
 - (a) Attenuation for the horizontal UTP cables, with maximum attenuation in dB per 305m (1000 feet) at 20°C.
 - (1) Voice cable at 1.0 MHz must have a maximum attenuation \leq (less than or equal to) 6.25 dB.(25 pair) per 305m (1000 feet) at 20°C.
 - (2) VIDEO/Coaxial cable at 100.0 MHz must have a maximum attenuation \leq (less than or equal to) 3.16 dB per 100 feet. at 20° C.
- B. Testing of fiber is mandatory and recommended to be performed with an HP-8140A Optic Loss Test Set or equivalent. The light loss on each fiber tested from end to end through port to port at both 850nm and 1300 nm shall not exceed 2.0 dB per fiber path.
- C. General: Upon completion of installation of telephone and Data systems, and after telephone/data wire circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with

new units, and proceed with testing. Demonstrate to Government that requirements for basic output signal levels, and values for attenuation and signal-to-noise ratios, have been achieved. Compliance is to be recorded in written form and given to Government prior to considering job complete.

1. Equipment such as patch panels and information outlets shall be tested with no failures or replaced.
2. Each horizontal or station wire shall have each pair pass testing or be replaced.
3. Each copper cable shall not have more than one pair per hundred that is unrepairable or it shall be replaced.

PART 3 - EXECUTION

3.1 PROJECT OVERVIEW – Not used.

3.2 EXAMINATION

- A. General: Examination areas and Conditions under which telephone systems are to be installed. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.3 INSTALLATION OF TELEPHONE / DATA SYSTEMS

- A. Installation: Install systems as indicated, in accordance with manufacturer's written instructions and with recognized industry practices (BICSI); ensure systems comply with installation and operational requirements of EIA/TIA, NEC and the Federal Communications Commission.
- B. Cable Labels: The specified labels will be placed at both ends of all horizontal cables (voice, data, and video) at no farther than 2 feet from the termination point unless visibility or access determines the label be placed at the closest visible point to the termination contact. Labeling system to be used as specified in plans and drawings. Labels are not to be placed under bracing points such as D rings or cable ties.
- C. Labeling of the Premises Distribution System Elements: Contractor shall be responsible for providing any labeling or identification of the feeder cables and demark and the Main Distribution Frame.
 1. The contractor shall label the riser cables and pairs. In addition, the feeder cables shall be tagged at both ends near the termination points and the pair count shall be marked on the wire blocks with indelible ink or equivalent.

2. In the main distribution frame, and the telecommunication jacks the cable pairs shall be laid down on the blocks according to standard telephone industry color code starting with pair one on the blocks. The blocks shall also be labeled with cable and pair counts.

3.5 INSTALLATION OF J-HOOKS

- A. Provide J-Hook supports from the structure above for all horizontal runs except where cables are run in cable trays. Spacing shall be a maximum of 4 feet 0 inches. Cables shall be located just above the ceiling. Cable shall not hot contact the ceilings, piping, light fixtures, ducts, etc. All cables must be suspended independently.

3.6 INSTALLATION OF TIE-WRAPS

- A. Tie-Wrap all cables (except patch cords) together between the J-Hooks, in the cable trays, and in the communications rooms. Spacing shall be a maximum of 4 feet 0 inches. No tie-wraps shall be placed over cable labels. The Tie-wraps shall be plastic, heavy duty, and flame retardant.

3.7 INTERIOR WALL PENETRATIONS

- A. When cables pass through walls, install 2 inch conduit sleeve through wall with bushed ends at both sides of wall. Provide fire barrier around conduit and seal conduit with fire barrier after cable installation. Seal cable tray penetrations through walls with fire barrier after cable installation.

3.8 DATA CONNECTOR TERMINATION PRACTICES

- A. For Category 5 (Data) Cables; minimize the amount of untwisting in a pair as a result of connecting to hardware for all terminations. For Category 5 cabling the amount of untwisting must not exceed the requirements for TIA/EIA TSB-40 (no greater than 13mm [0.5 inches])

3.9 DOCUMENTATION / RECORDS

- A. The Contractor shall provide, to client, two complete sets of as built blue prints upon completion of the project to show all PDS facilities. All cable and fiber routes, cable and fiber lengths, splices, cross connects, terminations and pair counts shall be documented on the prints as well as location of the MDF and telecommunications spaces and telecommunication cable routes on each floor. Computer CAD drawing files of the telecommunications drawings are available from the bid package. Verify associated costs prior to bidding

END OF SECTION 16741

SECTION 16770 - P.A. SYSTEM

PART I - GENERAL

1.1 DESCRIPTION:

- A. General paging system shall be designed and installed to deliver a minimum of 12dB. All speakers, back boxes, volume controls, amplifiers, cable, connectors, etc., shall be provided by the System Supplier. System supplier shall make final connections.
- B. All wiring shall be in conduit per Specifications Section 16110, except where routed concealed above accessible ceilings. Plenum rated cable shall be used where ceiling voids are used as air return plenums and cables are not routed in conduit.
- C. Refer to plans for locations of speakers, volume controls, and amplifiers..

PART 2 - PRODUCTS

2.1 SPEAKERS

- A. 8" loudspeaker/transformer, Atlas C10T70, 8" 100Z magnet, frequency response of 30 Hz to 19 KHz, dual cone, 97dB sensitivity, taps of .5, 1, 2, and 5 watts. Insertion loss 1.5dB. (Generally tapped at 1 watt).
- B. Enclosure assembly for suspended ceiling. Atlas 51-8 baffle, 95-8 back can and 81-8R bridge.
- C. Enclosure assembly for sheet rock ceiling. Atlas 51-8 baffle, 95-8 back can and P77-8 mounting ring.
- D. Enclosure assembly for surface mounting Atlas 164-8 baffle with 191-78 enclosure.
- E. Horn speaker for hanger area. University Sound #850T compound diffraction horn taped at watts, frequency response 250HZ-14KHZ, sensitivity 110dB, dispersion 120° x 60°.

2.2 VOLUME CONTROLS

- A. Volume control for 10 watts of speaker load or less. Atlas AT-10, 3dB per step, insertion loss of .4 dB, 1 gang size.

2.3 AMPLIFIER

- A. Amplifier for 35 watts of speaker load of less. (When speaker load is 90% of amplifier, utilize the next size up I amplifier. Peavey UMA35T, 1 microphone input, 1 switchable input of microphone/auxiliary. Frequency response of 50HZ-18KHZ + or - 1.5 dB. 1 auxiliary input. Input sensitivity High Z mic 5MV, low Z mic 500 UV, aux 150 MV, 35 watts output power.
- B. Amplifier for 300 watts of speaker load or less. Peavey IPA300T industrial power amp, 2 auxiliary inputs. Frequency response of 40HZ-20KHZ + or - 1.8 dB. Input sensitivity 1.0V RMS, 300 watts of output power.
- C. Telco Paging Adapter. (Used to interface the output of a telephone system with the auxiliary input of an amplifier). Atlas LT-600 V.C. transformer. Input ohms. Frequency response 60 Hz-12 KHz.
- D. Provide amplifiers with metal shelf for wall mounting.
- E. 1/3 Octive room equalizer (to serve Hanger Area). White 4700 with frequency response 20 Hz to 20 kHz. 1/3 octive increments within .5 db step balanced inputs/balanced outputs.

2.4 CABLE AND WIRING

- A. Speaker wire. West Penn #225 (non-plenum), 22525 (plenum) 2 cord #14 A.W.G.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the N.E.C., as shown on the drawings and as recommended by the System Supplier.

3.2 TESTING

- A. All components and wiring shall be completely tested by System Supplier. Test reports shall be included in maintenance manuals.

END OF SECTION 16770