



US Army Corps
of Engineers
Savannah District

Federal Facilities in North Carolina and South Atlantic Division

Solicitation Number

DACA21-03-R-0030

**Indefinite Delivery, Multi-Task Construction and
Design-Build Construction Contract**

**Volume III of III - Technical Provisions for Repair Fire
Suppression System, Building 4909 and Install Fire
Suppression, ATC Storage, Building 3420 and Building 3422,
Seymour Johnson AFB, NC**

August 2003

**THIS SOLICITATION IS UNRESTRICTED PURSUANT TO THE
"BUSINESS OPPORTUNITY DEVELOPMENT REFORM ACT OF 1988"
(PUBLIC LAW 100-656)**

**CORPS OF ENGINEERS
100 WEST OGLETHORPE AVENUE
SAVANNAH, GEORGIA 31401-3640**

SEYMOUR JOHNSON

Air Force Base

Goldsboro, North Carolina

SPECIFICATIONS

FOR

DATE: SEPTEMBER 10, 2002

PROJECT TITLE: REPAIR FIRE SUPPRESSION SYSTEM,
BLDG. 4909

PROJECT NO: VKAG 98-1125

PROJECT MANAGER: LT SHANNON EASTERLING



90%

RESUBMITTAL

**SEYMOUR JOHNSON AIR FORCE BASE
REPAIR FIRE SUPPRESSION SYSTEM
BLDG. 4909
PROJECT No. VKAG 98-1125**

SPECIFICATIONS

DIVISION 1 01000	GENERAL REQUIREMENTS GENERAL
DIVISION 2 02070 02300 02741 02920	SITE CONSTRUCTION SELECTIVE DEMOLITION EARTHWORK HOT-MIX ASPHALT PAVING LAWNS AND GRASSES
DIVISION 3 03300	CONCRETE CAST-IN-PLACE CONCRETE
DIVISION 4 04810	MASONRY UNIT MASONRY ASSEMBLIES
DIVISION 5 05210 05310	METALS STEEL JOISTS STEEL DECK
DIVISION 7 07210 07610 07841 07920	THERMAL AND MOISTURE PROTECTION BUILDING INSULATION STANDING SEAM METAL ROOFING THROUGH-PENETRATION FIRESTOP SYSTEMS JOINT SEALANTS
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DIVISION 9 09900	FINISHES PAINTING
DIVISION 13 13916 13956	SPECIAL CONSTRUCTION FIRE SUPPRESSION SPRINKLERS HIGH EXPANSION FOAM (Hi-X FOAM) FIRE PROTECTION SYSTEM
DIVISION 15 15446	MECHANICAL SUMP PUMPS
DIVISION 16 16060 16120 16130 16721	ELECTRICAL GROUNDING AND BONDING CONDUCTORS AND CABLES RACEWAYS AND BOXES FIRE DETECTION, ALARM AND RADIO TYPE REPORTING SYSTEM

SECTION 01000

GENERAL

- 1.1 SCOPE OF WORK: The work covered by this specification consists of furnishing all plant, labor, equipment and material, and performing all work in connection with VKAG 98-1125, REPAIR FIRE SUPPRESSION SYSTEM, BUILDING 4909 in strict accordance with these specifications and drawings and subject to the terms and conditions of this contract. The work area is in a secure area.
- 1.2 LOCATION: The work is to be accomplished at Seymour Johnson Air Force Base, Goldsboro, North Carolina. This base is accessible by both public highway and railway.
- 1.3 WORKWEEK: The contractor shall observe the same regular workweek being observed by the Seymour Johnson AFB Civil Engineering shop forces, which is 7:30 a.m. to 4:30 p.m., Monday through Friday, with Federal holidays excluded. Any deviation from this schedule will require 48 hours advance notice and approval of the Contracting Officer.
- 1.4 PRINCIPLE FEATURES: The work covered by this contract includes, but is not limited to the following:
- A. Concrete/Boring Work, Fire Suppression Sprinklers, Heads, Fire Alarm System, AFFF Under Wing Foam system, AFFF Retention System, and Construct AFFF Tank System.
- 1.5 HAUL ROUTES: The Contractor shall use the haul routes indicated on the plans.
- 1.6 DISPOSITION OF NONSALVAGEABLE MATERIALS: All nonsalvageable or unusable material shall be disposed of off base as directed by the Contracting Officer. All waste material generated by any work under this contract shall be handled, transported, stored, and disposed of off base, by the Contractor, in accordance with all applicable federal, state, or local laws, ordinances, regulations, court orders, or other types of rules or rulings having the effect of law.
- 1.7 DISPOSITION OF SALVAGEABLE MATERIALS: The Contractor shall be required to furnish an itemized listing of materials to be salvaged to the Base Civil Engineering material Control section, located in Bldg 3300, so that an AF Form 1348-1 can be obtained. After receiving this form, all salvable or reusable material will be delivered to the Defense reutilization and Marketing Office, which is located near Bldg 2620 or as directed by Contracting Officer.
- 1.8 SUBMITTALS REQUIRED: Required submittals are listed on AF Form 66.

- 1.9 BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST, AF FORM 103: The Contractor shall obtain AF Form 103, Base Civil Engineering Work Clearance Request, prior to work commencement from the Contract Management Section in Bldg 3300, 1095 Peterson Avenue. Upon receipt of an AF Form 103, the Contractor shall be responsible for locating all base owned underground utilities, as well as, coordinating local utility companies to stake out utilities if not owned by the base. Historical drawings, as-built drawings, and topographic drawings are available for review at the 4th Civil Engineer Squadron, Design element located in Building 3300. Base owned utilities include but are not limited to electric, water, sewer, steam, communication, telephone, fiber optic, cathodic protection, and fuel lines. Utilities not owned by the base include but are not limited to cable TV, Southern Bell Telephone, and Natural Gas. The Contractor shall contact ULOCO and the non-base utility companies for location services. It is the responsibility of the Contractor to locate and mark applicable utilities during construction. In the event that the Contractor damages a utility which is commented in the plans, record drawings, or located by a utility locator, the Contractor shall repair/replace the utility at no additional cost to the Government. Utilities not documented, shown, or located by a locator shall be considered abandoned or unknown. Contractor damage to unknown or abandoned utilities shall be dealt with as a differing site condition.
- 1.10 SAFETY: All safety requirements of the U.S. Army Corps of Engineers Safety Manual 385-1-1 dated October 1996 will be strictly adhered to as related to all work covered under these specifications.
- 1.11 MATERIALS CONTAINING ASBESTOS: In the event the Contractor discovers materials suspected of containing asbestos that is not identified to be removed in the plans and specifications, the Contractor shall notify the Contracting Officer. The Contractor's work shall proceed unless the materials suspected of containing asbestos are damaged or disturbed. Any suspected materials damaged or disturbed by the Contractor without permission from the Contracting Officer shall be removed by the Contractor at his expense IAW all applicable Federal, State, and local laws, ordinances, regulations, court orders, or other types of rules or rulings having the effect of law.
- 1.12 LABELING OF STORAGE DRUMS: All 55 gallon or larger drums brought on base for use under this contract and containing new material or used for storage of waste materials or hazardous waste must be labeled with a Department of Transportation (DOT) Proper Shipping Name, DOT Hazardous Identification Number, the Contractor's name, a Contractor representative, and the Contractor's telephone number. Label lettering should have a minimum height of one half inch painted in white paint or other color that is in contrast with the color of the drum. The label should be sufficiently durable to equal or exceed the life (including storage and disposal) of the drum.
- 1.13 CONTRACTOR STORAGE TRAILER(S) AND BUILDING(S): The Contractor shall place or paint a sign on all of his storage trailer(s) and building(s) used on this contract. At a minimum, the sign shall contain the name of the Contractor and a telephone number at which the Contractor can be reached. The trailer(s) and building(s) shall be

complete with gates and/or doors which can be locked. Only material for this project shall be stored in the trailer(s) or building(s). The Contractor shall remove the storage trailer(s) or building(s) within 30 days after completion of the contract and prior to submitting his final invoice. The area around the storage trailer(s) and building(s) shall be kept clean. This includes the mowing of grass during the growing season. The lawn mower shall be supplied by the Contractor.

- A. The Contractor will be given a lot in the Contractor Storage Area behind Bldg 2700 for the life of the contract. The Contractor's progress schedule shall include a line item (equal to 1%) for final cleanup of this storage lot. Final payment will not be made until this final cleanup is performed by the Contractor and accepted by Seymour Johnson AFB.

1.14 PHASING:

- A. The 45 days following Contractor's Notice to Proceed (Phase I) will be allowed for delivery of materials, equipment ordering, and submittal approval only. No on-site work shall be permitted by the Contractor during that initial 45 day period.
- B. After the submittal phase, the performance period (Phase II) will take 120 days.

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C - Contractor shall phase work in the following manner:

1. West Side of Hangar – All work requiring the west side of the hangar to have no aircraft present shall be accomplished first. This work includes, but is not limited to, the following:
 - a. Install foam generators 9, 10, 11, and 12, with structural support steel and roof penetrations.
 - b. Install overhead piping, conduit, and wiring west of column line H.
 - c. Replace existing sprinkler heads west of column line H.
2. East Side of Hangar – All work requiring the east side of the hangar to have no aircraft present shall be accomplished after work required by Paragraph 1.14.C.1 is complete. The work requiring the east side of the hangar to have no aircraft present includes, but is not limited to, the following:
 - a. Install foam generators 1, 2, 3, and 4, with structural support steel and roof penetrations.
 - b. Install overhead piping, conduit, and wiring east of column line E.
 - c. Replace existing sprinkler heads east of column line E.
3. Both Aircraft Removed - All work requiring no aircraft to be present in the hangar shall be accomplished after work in Paragraphs 1.14.C.1 and 1.14.C.2 is complete. The work requiring no aircraft to be present in the hangar includes, but is not limited to, the following:
 - a. Install foam generators 5, 6, 7, and 8, with structural support steel and roof penetrations.

- b. Install overhead piping, conduit, and wiring between column lines E and H
 - c. Replace existing sprinkler heads between column lines E and H.
 - d. Modify north manifold, install new valve, replace existing deluge valve (requires fire suppression system shutdown).
 - e. Replace existing deluge valves on south manifold (requires fire system suppression shutdown).
 - f. Connect new fire alarm control panel to existing device circuits (require fire alarm system shutdown).
4. Work Not Requiring Aircraft to Be Out of Hangar – All work not requiring one or more aircraft to be out of the hangar may be performed at any time during the performance period as needed and may be performed concurrently with any other phase of the work. This work includes, but is not limited to, the following:
- a. Install wall louvers on column lines 1 and 7.
 - b. Install deluge valve stations on roof of CAMS office, north and south.
 - c. Install overhead piping, conduit, and wiring east of column line 6.
 - d. Install foam test manifold.
 - e. Construct foam tank room.
 - f. Install equipment within foam tank room.
 - g. Install fire alarm control panel, devices, and wiring inside and outside offices, and around periphery of hangar.

All outdoor work to include installing manholes, water lift station, and force main piping to pond.

1.15 AFFIRMATIVE PROCUREMENT:

- A. The contractor shall incorporate Affirmative Procurement requirements as per 40 CFR, Part 247 and Executive Order 13101: “Greening the Government Through Waste Prevention, Recycling and Federal Acquisition.” Designated items used in the execution of this contract shall meet or exceed the Environmental Protection Agency’s (EPA) requirements for recycled content materials (RCM) as per the EPA’s Comprehensive Procurement Guidelines (CPG). The contractor/engineer shall ensure affirmative procurement requirements for CPG items are met or provide written justification that: 1) The price of a given designated item is unreasonably high, 2) There is inadequate competition (not enough sources of supply), 3) Unusual and unreasonable delays would result from obtaining the item, or 4) The item does not meet the Air Force’s performance specifications.

END OF SECTION 01000

SECTION 02070

SELECTIVE DEMOLITION

1.1 GENERAL

A. Definitions:

1. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
2. Remove and Salvage: Detach items from existing construction and deliver them to the Government.
3. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
4. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. 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 Contractor's property and shall be removed from Project site.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Project Conditions:

1. The Government will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so the Government 's operations will not be disrupted. Provide not less than 48 hours' notice to the Government of activities that will affect the Government 's operations.
2. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
3. the Government assumes no responsibility for condition of areas to be selectively demolished.
 - a. Conditions existing at time of inspection for bidding purpose will be maintained by the Government as far as practical.

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

G. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

1.2 PRODUCTS

- A. Repair Materials: Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.

1.3 EXECUTION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- B. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to the Contracting Officer or authorized representative.
- C. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- E. Utility Requirements: Locate, identify, disconnect, shut off, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 1. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
- F. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- G. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
- H. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

- I. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
- J. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- K. Temporary Shoring: Provide and maintain interior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- L. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
- M. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- N. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.
- O. Selective Demolition: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. 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.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. 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.
 - 4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- P. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- Q. Removed and Reinstalled Items: Comply with the following:
 - 1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.

2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- R. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Contracting Officer or authorized representative, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- S. Patching and Repairs: Promptly repair damage to adjacent construction caused by selective demolition operations.
1. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 2. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
- T. Disposal of Demolished Materials: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
1. Burning: Do not burn demolished materials.
 2. Disposal: Transport demolished materials off the Government's property and legally dispose of them.

END OF SECTION 02070

SECTION 02300

EARTHWORK

1.1 GENERAL

A. Definitions in this Section include the following:

1. Backfill: Soil materials used to fill an excavation.
2. Base Course: Layer placed between the subbase course and asphalt paving.
3. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
4. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
5. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
6. Excavation: Removal of material encountered above subgrade elevations.
7. Fill: Soil materials used to raise existing grades.
8. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
9. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.
10. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
11. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Government or others unless permitted in writing and then only after arranging to provide temporary utility services according to requirements indicated.

1.2 PRODUCTS

- A. Soil Materials: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
- D. Backfill and Fill: Satisfactory soil materials.

- E. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- F. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- G. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.
- H. Detectable Warning Tape: Polyethylene film warning tape encasing a metallic core, minimum 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility.

1.3 EXECUTION

- A. 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.
- B. Provide erosion- and sedimentation-control measures.
- C. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- D. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
- E. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- F. Excavate for structures, pavements, and walks to indicated elevations and dimensions. Extend excavations for placing and removing concrete formwork, for installing services and other construction, and for inspections. Trim bottoms to required lines and grades to leave solid base to receive other work.
- G. Excavate utility trenches to indicated gradients, lines, depths, and invert elevations of uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit.

1. Excavate trenches deeper than bottom of pipe elevation, 6 inches (150 mm) deeper in rock, 4 inches (100 mm) deeper elsewhere, to allow for bedding course. Hand excavate for bell of pipe.
- H. Proof roll subgrades, before filling or placing aggregate courses, with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.
- I. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities.
- J. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by the Contracting Officer or authorized representative.
- K. Stockpile borrow materials and satisfactory soil materials, without intermixing, in shaped, graded, drained, and covered stockpiles. Stockpile soil materials away from edge of excavations and outside drip line of remaining trees.
- L. Utility Trench Backfill: Place, compact, and shape bedding course to provide continuous support for pipes and conduits over rock and other unyielding bearing surfaces and to fill unauthorized excavations.
1. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit. Place and compact final backfill of satisfactory soil material to final subgrade.
 2. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.
- M. Fill: Place and compact fill material in layers to required elevations.
- N. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
1. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
- O. Compaction: Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- P. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 92 percent.
 3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 85 percent.
- Q. Grading: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated. Grade lawns, walks, and unpaved subgrades to tolerances of plus or minus 1 inch (25 mm) and pavements and areas within building lines to plus or minus 1/2 inch (13 mm).
- R. Subbase and Base Courses: Under pavements and walks, place subbase course on prepared subgrade. Place base course material over subbase. Compact to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
- S. Under slabs-on-grade, place drainage course on prepared subgrade. Compact to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
- T. Testing Agency: The Contractor will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
1. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
 2. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.
- U. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction.
- V. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
- W. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Government's property.

END OF SECTION 02300

SECTION 02741
HOT-MIX ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes hot-mix asphalt patching.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be registered with and approved by authorities having jurisdiction or the DOT of the state in which Project is located.
- B. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
 - 1. Tack Coat: Minimum surface temperature of 60 deg F (15.5 deg C).
 - 2. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.5 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.
- B. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.
- C. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO MP 1, PG 64-22, PG 58-28.
- B. Tack Coat: emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 MIXES

- 1. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by Contracting Officer or Authorized Representative; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types".

PART 3 - EXECUTION

3.1 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
- C. Patching: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

3.2 SURFACE PREPARATION

- A. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
 - 1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- F. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.4 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
 - 1. Surface Course: 1/8 inch.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.6 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 02741

SECTION 02920

LAWNS AND GRASSES

1.1 GENERAL

- A. Submittals: In addition to Product Data for each type of product indicated, submit a planting schedule indicating anticipated planting dates.
- B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory.
- C. Lawn Maintenance: Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Seeded Lawns: 60 days from date of Substantial Completion.
 - 2. Mow lawn as soon as top growth is tall enough to cut. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings.

1.2 PRODUCTS

- A. Seed Species: State-certified seed of grass species, as follows:
 - 1. Full Sun: Fescue.
 - 2. Sun and Partial Shade: Proportioned by weight as follows:
 - a. 50 percent Fescue.
- B. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.
 - 1. Topsoil Source: Reuse surface soil stockpiled on-site and supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Verify suitability of stockpiled surface soil to produce topsoil.
- C. Fertilizer:
 - 1. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in composition suitable for site conditions.
- D. Mulches:
 - 1. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

1.3 EXECUTION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 3 inches. Remove stones larger than 3/4 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off the Government's property.
 - 1. Apply fertilizer (if needed) directly to subgrade before loosening.
- B. Unchanged Subgrades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare surface soil as follows:
 - 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 - 2. Loosen surface soil to a depth of at least of 6 inches. Apply fertilizer and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
 - 3. Remove stones larger than 3/4 inches in any dimension and sticks, roots, trash, and other extraneous matter.
 - 4. Legally dispose of waste material, including grass, vegetation, and turf, off the Government's property.
- C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1 inch of finish elevation.
- D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- E. Restore areas if eroded or otherwise disturbed after finish grading and before planting.
- F. Seeding: Sow seed at the rate located on Seeding Schedule shown on Drawing C3.1.
 - 1. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.
 - 2. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 3. Protect seeded areas from hot, dry weather or drying winds within 24 hours after completing seeding operations. Soak and scatter uniformly to a depth of 3/16 inch and roll to a smooth surface.
- G. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
- H. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

END OF SECTION 02920

SECTION 03300

CAST-IN-PLACE CONCRETE

1.1 GENERAL

- A. Submittals: In addition to Product Data, submit design mixes and the following for each concrete mix:
 - 1. Shop Drawings detailing fabrication, bending, and placement.
 - 2. Material certificates signed by product manufacturers certifying that product complies with requirements.
- B. Quality Assurance: Comply with ACI 301, "Specification for Structural Concrete," and ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 1. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1.2 PRODUCTS

- A. Steel Reinforcement: As follows:
 - 1. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
 - 2. Plain-Steel Wire: ASTM A 82, as drawn.
- B. Synthetic Fiber:
 - 1. Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, ½ to 1-1/2 inches long. Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.
- C. Concrete Materials: As follows:
 - 1. Portland Cement: ASTM C 150, Type I.
 - 2. Aggregate: ASTM C 33, uniformly graded, from a single source throughout the project.
 - 3. Water: ASTM C 94, shall be clean, fresh, free from oil, organic matter, or other deleterious substances.
 - 4. Air-Entraining Admixture: ASTM C 260, Products shall be (or approved equal):
 - a. Air-Mix or AEA 92 by the Euclid Chemical Company.
 - b. MB-VR by Master Builders.
 - c. Darex Series or Daravair Series by W.R. Grace & Co.
 - 5. Water-Reducing Admixture: ASTM C 494, Type A. Shall not contain more chloride ions than are present in municipal drinking water. Products shall be (or approved equal):
 - a. Eucon WR-75 by The Euclid Chemical Company.

- b. Pozzolith 200N by Master Builders.
 - c. WRDA Series by W.R. Grace & Co.
6. High-Range, Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F. Shall not contain more chloride ions than are present in municipal drinking water. Products shall be (or approved equal):
 - a. Eucon 37 by The Euclid Chemical Company.
 - b. Rheobuild 1000 by Master Builders.
 - c. ADVA Series or Davacon Series by W.R. Grace & Co.
 7. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E. Shall not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Products shall be (or approved equal):
 - a. Accelguard 80 by The Euclid Chemical Company.
 - b. Polarset or Lubricon NCA by W. R. Grace Company.
 8. Water-Reducing and Retarding Admixture: ASTM C 494, Type D. Water Reducing, Retarding Admixture: Shall not contain more chloride ions than are present in municipal drinking water. Products shall be (or approved equal):
 - a. Eucon Retarder-75 by The Euclid Chemical Company.
 - b. Possolith 100XR by Master Builders.
 - c. Daratard-17 by W.R. Grace & Co.
 9. Fly Ash: ASTM C 618, Type F. Fly ash shall be obtained from one source for the concrete delivered to the project and not exceed 20 percent of the total cementitious material.

D. Related Materials: As follows:

1. Self-Expanding Strip Waterstops: Rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material.
2. Vapor Retarder: Polyethylene sheet, ASTM D 4397, thickness on Drawings.
3. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
4. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
5. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, of type, class, and grade to suit requirements.

E. Curing Materials: As follows:

1. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
2. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
3. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
4. Clear, Solvent-Borne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
5. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

6. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 7. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- F. Concrete Mixes: Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, with the following properties:
1. Compressive Strength (28 Days): 3,000 psi or as indicated on Drawings.
 2. Slump: 3 to 4 inches.
 3. Air Content: 4.5 to 7.0 percent for all exterior concrete subject to freezing and thawing.
- G. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
- H. Non-shrink Grout:
1. The non-shrink grout shall be:
 - a. Euco NS by The Euclid Chemical Company.
 - b. Five Star Grout by the U.S. Grout Corporation.

The factory pre-mixed grout shall conform to ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 4' x 4' base plate.
 2. The high flow grout shall be used where high fluidity and/or increase placing time is required. Products shall be:
 - a. Euco Hi-Flow Grout by The Euclid Chemical Company.
 - b. Masterflow 928 by Master Builders.

The factory pre-mixed grout shall conform to ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 18" x 36" base plate.

1.3 EXECUTION

- A. Design, construct, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- C. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved 28-day design compressive strength.

- D. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.
- E. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643.
- F. Steel Reinforcement: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- G. Joints: Locate and install construction, isolation, and contraction joints.
- H. Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions.
- I. Concrete Placement: Deposit concrete continuously and avoid segregation. Deposit concrete in forms in horizontal layers no deeper than 24 inches, avoiding cold joints.
 - 1. Consolidate concrete with mechanical vibrating equipment.
 - 2. Screed and initial-float concrete floors and slabs using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
 - 3. Comply with ACI 306.1 for cold-weather concrete placement.
 - 4. Place concrete according to recommendations in ACI 305R when hot-weather conditions exist.
- J. Finish formed surfaces as follows:
 - 1. Apply rough-formed finish, defined in ACI 301, to concrete surfaces indicated or not exposed to public view.
 - 2. Apply smooth-formed finish, defined in ACI 301, to concrete surfaces indicated and exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
 - 3. Apply smooth-rubbed finish to smooth-formed finished concrete surfaces indicated or exposed to public view.
- K. Finishing Floors and Slabs: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Finish unformed surfaces as follows:
 - 1. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing.
 - 2. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.

3. Nonslip Broom Finish: Apply a nonslip broom finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
- L. Concrete Protection and Curing: Protect concrete from excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
 1. Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause excessive moisture loss.
 2. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
 3. Cure formed and unformed concrete for at least seven days by moisture curing, moisture-retaining-cover curing, or curing compound.
 4. Cure and seal floors and slabs with a curing and sealing compound according to manufacturer's written instructions.
- M. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement.
- N. Defective Concrete: Repair and patch defective areas when approved. Remove and replace concrete that cannot be repaired and patched.

END OF SECTION 03300

SECTION 04810

UNIT MASONRY ASSEMBLIES

1.1 GENERAL

- A. Submittals: In addition to Product Data, submit the following:
 - 1. Samples showing the full range of colors and textures available for exposed masonry units and colored mortars.
 - 2. Material Certificates: For each type of masonry unit required.
- B. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.
- C. Hot-Weather Requirements: When ambient temperature exceeds 100 deg F (38 deg C), or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar.

1.2 PRODUCTS

- A. Concrete Masonry Units: ASTM C 90 and as follows:
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
 - 2. Weight Classification: Normal weight.
 - 3. Provide Type II, nonmoisture-controlled units.
 - 4. Color: Gray, unpainted.
 - 5. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
- B. Mortar and Grout Materials: As follows:
 - 1. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
 - 2. Hydrated Lime: ASTM C 207, Type S.
 - 3. Mortar Cement: ASTM C 1329.
 - 4. Masonry Cement: ASTM C 91.
 - 5. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
 - 6. Aggregate for Grout: ASTM C 404.
 - 7. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units.
 - 8. Water: Potable.

- C. Steel Reinforcing Bars: ASTM A 615, Grade 60.
- D. Masonry Joint Reinforcement: ASTM A 951; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.
 - 1. Wire Size for Side Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
 - 2. Wire Size for Cross Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
 - 3. For single-wythe masonry, provide either ladder or truss type with single pair of side rods and cross rods spaced not more than 16 inches (407 mm) o.c.
- E. Miscellaneous Masonry Accessories: As follows:
 - 1. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene, urethane or PVC.
 - 2. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- F. Masonry Cleaners: As follows:
 - 1. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.
- G. Mortar and Grout Mixes: Do not use admixtures, unless otherwise indicated. Do not use calcium chloride in mortar or grout.
 - 1. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification.
 - a. Extended-Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above, at Contractor's option.
 - b. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
 - c. For masonry below grade, in contact with earth, and where indicated, use Type S.
 - d. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 2. Grout for Unit Masonry: Comply with ASTM C 476.
 - a. Use grout of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - b. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143.

- H. Source Quality Control: Contractor will engage a qualified independent testing agency to perform source quality-control testing indicated below. Payment for these services will be made by the Government.
 - 1. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

1.3 EXECUTION

- A. Cut masonry units with motor-driven saws. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
- C. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:
 - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.
 - 2. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.
- D. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- E. Bond Pattern for Exposed Masonry: Lay exposed masonry in bond pattern indicated; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- F. 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.
- G. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- H. Lay hollow masonry units as follows:
 - 1. With full mortar coverage on horizontal and vertical face shells.
 - 2. 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.
 - 3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
- I. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.

- J. Provide continuous masonry joint reinforcement as indicated. Install with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
1. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections.
- K. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.
1. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- L. Placing Reinforcement: Comply with requirements of ACI 530.1/ASCE 6/TMS 602.
- M. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
- N. Cleaning: Clean unit masonry as follows:
1. By dry brushing to remove mortar fins and smears before tooling joints, as work progresses.
 2. After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - a. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 - b. Protect adjacent surfaces from contact with cleaner.
 - c. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
 - d. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.
- O. Masonry Waste Disposal: Dispose of clean masonry waste, including broken masonry units, waste mortar, and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
1. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.
 2. Remove excess, clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off the Government's property.

END OF SECTION 04810

SECTION 05210

STEEL JOISTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Open-web, K-series steel joists.

1.2 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product indicated.
- B. Shop Drawings: Showing layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.
- C. Welding certificates.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.
 - 1. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.
- B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for chord and web members.
- B. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers; plain, uncoated.
- C. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers; plain, uncoated.

2.2 PRIMERS

- A. Primer: SSPC-Paint 15, Type I, red oxide; FS TT-P-636, red oxide; or manufacturer's standard shop primer complying with performance requirements of either of these red-oxide primers.

2.3 STEEL JOISTS

- A. Manufacture steel joists according to SJI's "Specifications," with steel-angle top- and bottom-chord members, and as follows:
 - 1. Manufacture steel joists according to "Standard Specifications for Open Web Steel Joists, K-Series," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.
- B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications."
- C. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.5 SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Apply 1 shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
- C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts, unless otherwise indicated.
- E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

END OF SECTION 05210

SECTION 05310

STEEL DECK

1.1 GENERAL

- A. Submittals: In addition to Product Data for each type of deck and accessory, submit the following:
 - 1. Shop Drawings showing layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.
 - 2. Product certificates signed by steel deck manufacturers certifying that products furnished comply with requirements.
- B. Quality Assurance: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" for calculating structural characteristics of steel deck.
 - 1. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.2 PRODUCTS

- A. Steel Roof Deck: Fabricate panels to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 29, and the following:
 - 1. Galvanized Steel Sheet: ASTM A 653.
 - 2. Deck Profile: Type NR, narrow rib.
 - 3. Profile Depth: 1-1/2 inches.
 - 4. Design Uncoated-Steel Thickness: 0.0295 inch.
- B. Accessories: Steel deck manufacturer's standard accessory materials, including mechanical fasteners, closure strips, pour stops, and closures for deck.

1.3 EXECUTION

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.
 - 1. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 2. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
 - 3. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking.

4. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.
 5. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- B. Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

END OF SECTION 05310

SECTION 06105

MISCELLANEOUS CARPENTRY

1.1 GENERAL

A. Submittals:

1. Product Data: For wood-preservative and fire-retardant treatment from chemical treatment manufacturers and certification by treating plants that treated materials comply with requirements.

1.2 PRODUCTS

A. Lumber, General: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review. Factory mark each piece of lumber with grade stamp of grading agency.

1. For exposed lumber, mark grade stamp on end or back of each piece.
2. Provide dressed lumber, S4S, unless otherwise indicated.
3. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

B. Wood-Preservative-Treated Materials: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
2. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
3. Application: Treat items indicated on Drawings, and the following:
 - a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - b. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - c. Wood framing members less than 18 inches (460 mm) above grade.
 - d. Wood floor plates that are installed over concrete slabs directly in contact with earth.

C. Fire-Retardant-Treated Materials: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use Exterior type for exterior locations and where indicated.
 2. Use Interior Type A High Temperature (HT), unless otherwise indicated.
- D. Provide miscellaneous lumber for support or attachment of other construction.
1. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content of any species.
- E. Miscellaneous Concealed Plywood: Exterior sheathing, span rating to suit framing in each location, and thickness as indicated but not less than 1/2 inch (13 mm).
- F. Fasteners: Provide fasteners of size and type indicated.
1. Where carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 2. Power-Driven Fasteners: CABO NER-272.
 3. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings.

1.3 EXECUTION

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
- C. Wood Structural Panels: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.

END OF SECTION 06105

SECTION 07210
BUILDING INSULATION

1.1 GENERAL

- A. Submittals: Product Data for each type of insulation indicated.

1.2 PRODUCTS

- A. General: Provide insulating materials that comply with requirements and with referenced standards For preformed units, provide sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.
- B. Nailable Insulation: Polyisocyanurate Board Insulation, ASTM C 1289, Type I, 2 pcf density, 2-inch (50-mm) minimum thickness with factory laminated 7/16-inch (11-mm) thick APA rated Oriented Strand Board (OSB); maximum flame-spread and smoke-developed indices of 75 and 450, respectively, based on tests performed on unfaced core on thicknesses up to 4 inches (101 mm).

1.3 EXECUTION

- A. Installation:
1. General: Install insulation to comply with insulation manufacturer's written instructions applicable to products and application indicated. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
 2. Protect top surface of perimeter horizontal insulation from damage during work by applying protection board.

END OF SECTION 07210

SECTION 07610

STANDING SEAM METAL ROOFING

PART 1 - GENERAL

A. System Description:

1. Design and Performance Criteria:
 - a. Thermal Movement: Completed metal roofing and flashing system capable of withstanding expansion and contraction of components caused by temperature range from -10° F to +120 ° F without buckling, producing excess stress on structure, anchors or fasteners, or reducing performance ability.
2. Uniform Wind Load Capacity:
 - a. Capacity determined in compliance with AA publication "Specification for Aluminum Structures", 1986 Edition, and principles of ASTM E330, Procedure A, adapted to testing roof panels as follows:
 - (7.1) Roof test specimens either full length or representative of main body of roof, free from edge restraint of perimeter attachments, continuous over one or more supports, and containing at least five panel modules for standing seam roof.
 - (7.2) No attachments are permitted at sides or end perimeter other than those that occur uniformly throughout roof. Side and end seals shall be flexible and in no way restrain crosswise distortion of panels.
 - (7.2.1) Panels and accessories production materials of same type and thickness proposed for use on Project.
 - (10.1.1) Seals or film shall not span any crevices or cracks that may tend to separate under pressure.
 - b. Installed roof system shall withstand positive or negative design wind loading pressures complying with 1994 Uniform Building Code with 1997 Revisions and 1994 North Carolina State Building Code with 1999 Revisions, with maximum system deflection of L/140 and maximum panel deflection of 0.04% and in compliance with ASCE 7-93, UL 90 and ASTM E1592.
3. Concentrated Load Capacity: Withstand load of 250 lbs. applied to four-inch by four-inch square area located in center of panel between stiffener ribs without buckling of ribs or permanent panel distortion.

4. Water Penetration (Dynamic Pressure): No uncontrolled water penetration, other than condensation, when tested in compliance with ASTM E1646 at minimum differential pressure of 20 percent of inward acting, wind load design pressure of 6.24 psf and not more than 12 psf.
5. Air Infiltration: Provide preformed roof panel assemblies with permanent resistance to air leakage through assembly of not more than 0.09 cfm/sq. ft of fixed roof area when tested according to ASTM E1680 at static air pressure difference of 4.0 lbf/sq. ft.
6. Capacities for gauge, span or loading other than those tested may be determined by interpolation of test results within range of test data. Extrapolation for conditions outside test range is not acceptable.

1.2 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
 1. A792-93a Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, General Requirements.
 2. D1056-91 Flexible Cellular Materials – Sponge or Expanded Rubber.
 3. E1592-94 Test Method for Structural Performance of Sheet Metal Roofing and Siding Systems by Uniform Air Pressure Difference.
 4. E1646-95 Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
 5. E1680-95 Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems.
- B. Architectural Aluminum Manufacturers Association (AAMA):
 1. 501-83 Methods of Test for Metal Curtain Walls.
 2. 605.2-92 Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
- C. American Society of Civil Engineers (ASCE):
 1. 7-95 Minimum Design Loads for Buildings and Other Structures.
- D. National Roofing Contractors Association (NRCA):
 1. The NRCA Construction Details – Third Edition.
- E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):
 1. Architectural Sheet Metal Manual, Fifth Edition, 1993.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's detailed material and system description, installation instructions, and engineering performance data and finish specifications.
- B. Shop Drawings: Show roofing system with flashings and accessories in plan and elevation; sections and all details at full scale. Include metal thicknesses and finishes, panel lengths, joining details, anchorage details, flashings and special fabrication

provisions for termination and penetrations; girt locations expansion provisions and special supports. Indicate relationships with adjacent and interfacing work.

- C. Samples:
 - 1. Panel section, minimum 2'-0" in length by full width, indicating thickness, profile, texture and color.
 - 2. Submit samples of panel clips, closures, insulation and accessory items.
- D. Design Calculations: Submit design calculations, indicating compliance with specified performance criteria. Design calculations shall bear seal of registered engineer licensed to practice in the State of North Carolina. Indicate that engineer has reviewed shop drawings.
- E. Test Reports:
 - 1. Submit reports by independent testing laboratory to support structural calculations and show compliance with specified performance criteria.
 - 2. Tests shall have been made for substantially identical systems within ranges of specified performance criteria.
 - 3. If test data is not available, or if data does not represent project conditions, Contractor shall be responsible for securing satisfactory tests by independent testing agency acceptable to Contracting Officer or authorized representative, with all costs of such testing borne by Contractor.

1.4 QUALITY ASSURANCE

- A. Fabricator/Installer Qualifications:
 - 1. Installer trained and approved by system manufacturer, with trained supervisory personnel observing and directing work.
 - 2. If required, proposed fabricator/installer shall submit work and proof of adequate financial responsibility. Contracting Officer or authorized representative reserves the right to inspect fabrication facilities in determining qualifications.
- B. Fire-Test-Response Characteristics: Where fire-resistance-rated roof panel 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.
- C. Preinstallation Conference; Prior to beginning metal roofing work, prerooting conference will be held to review work to be accomplished.
 - 1. Contractor, Contracting Officer or authorized representative, metal roofing subcontractor, metal roofing system manufacturer's representative and all other subcontractors who have equipment penetrating roof or whose work involves access to roof shall be present.
 - 2. Contractor shall notify Contracting Officer or authorized representative and other attending parties' minimum three days prior to time for conference.
 - 3. Contractor shall record minutes of meeting and shall distribute copies of minutes to attending parties.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect components during fabrication, shipment, storage, handling, and erection from mechanical abuse, stains, discoloration, and corrosion.
- B. Maintain strippable plastic protective film on finished surfaces until panel is erected.
- C. Store materials off ground, adequately shored, and under cover and protected from wind movement, foreign material contamination, mechanical damage, cement, lime, or other corrosive substances.
- D. Handle materials to prevent damage to surfaces, edges and ends of roofing sheets and sheet metal items. Damaged material shall be rejected and removed from site.
- E. Protect panels from wind related damages during erection.
- F. Inspect materials upon delivery. Reject and remove from site physically damaged or marred material.

1.6 WARRANTY

- A. Endorse and Forward to Government Following Warranties:
 - 1. Manufacturer's twenty-year warranty covering replacement of defective materials, structural defects and corrosion.
 - 2. Applicator's five year finish warranty covering refinishing of fluoropolymer coating due to checking, crazing, peeling, chalking or fading.
 - 3. Installer's five-year warranty covering roofing system installation and watertightness.
 - 4. All warranties shall commence on Date of project acceptance by Contracting Officer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer and Type: Berridge Manufacturers (or approved equal) "Zee-Lock", prefinished 24 "galvalume" standing seam metal roofing system in color to match Petersen's Aluminum "Dark Bronze".
- B. Other Acceptable Manufacturers (or approved equal):
 - 1. Berridge Manufacturing Co.
 - 2. Carlisle Engineered Metals
 - 3. Merchant & Evans, Inc.
 - 4. Smith-Steelite, Inc.
 - 5. Zip-Rib, Inc.

2.2 METAL ROOFING SYSTEM

A. Materials:

1. Panel Material: ASTM A792, 24 gauge, prefinished "Galvalume" sheet comprised of 55% aluminum, 1.6% silicon and the balance zinc.
2. Flashing and Flat Stock Material: 24 gauge thickness galvalume of same type and finish as panels.
3. Finish on Exposed Surfaces: Two coat shop-applied, baked on fluoropolymer coating system based on Elf Arochem "Kynar 500" resin or Ausimont "Hylar 5000" resin (Polyvinylidene fluoride, PVDF), formulated by licensed manufacturer and applied by manufacturer's approved applicator to meet AAMA Publication 605.2.
 - a. Coating System: Minimum 1.3 mil dry film thickness consisting of 0.3 (+ 0.1) mil primer, minimum 1.0 mil color coat. Both color coat and clear top coat containing minimum 70% polyvinylidene fluoride resin by weight; complying with AAMA 1402, Test Method No. 7.
 - b. Color: Custom to match Petersen Aluminum "Dark Bronze".
4. Finish on Unexposed Interior Face: Neutral wash coat.
5. Protective Surfacing: Provide strippable plastic film covering on finish surfaces to prevent abrasion during fabrication, storage and handling.

B. Characteristics:

1. Configuration: Standing seams incorporating mechanically interlocked, concealed anchor clips allowing thermal movement, and of configuration which will prevent entrance or passage of water.
2. Seam Height: 1-1/2 inch minimum.
3. Panel Width: 16-1/2" o.c. between standing seams.
4. Panel Surface: Smooth.
5. Stiffener Ribs: 3/8-inch maximum, spaced 4-inches to 6-inches o.c., parallel to seams.
6. Panel Length: Full length without joints, including bends, where applicable.
7. Seam Cap: Provide shop fabricated cap for seams where cut for bends. Cap shall match seam, with mitered and sealed bend.
8. Replaceability: Individual panels shall be removable for replacement without removing adjacent panels.

C. Accessories:

1. Anchor Clips: 18 gauge domestic galvanized steel, 33 ksi yield strength, double strength, double fastener with UL imprint, designed to receive recessed mechanical anchor into decking or structural support elements, girts or blocking. Clips shall allow free thermal expansion and contraction movement, relative to structure, within full temperature ranges specified.
2. Anchors: Noncorrosive cadmium plated hardened self-drilling hexagonal head steel screws designed to meet structural loading requirements.
3. Exposed Fasteners: Stainless steel self-tapping hexagonal head screws with neoprene sealing washers. #14 size minimum, head finished to match panel color.
4. Closures: Factory pre-cut closed cell foam complying with ASTM D1056, Grade SCE-41 (EPT), and field fabricated PVC hip closures, enclosed in metal channel matching panels when used at hip and ridge.

5. Provide all miscellaneous accessories for complete installation. All accessories shall be furnished by roofing system manufacturer.
6. Wood Deck Substrate: Pressure preservative treated plywood as specified in Section 06105; sizes indicated.

2.3 FABRICATION

- A. Prefabricate metal roof panels and flashing components to maximum extent possible, forming metal work with clear, sharp, straight and uniform bends and arrises. Hem exposed edges of flashings.
- B. Form flashing components from full single width sheet. Provide shop fabricated, mitered corners, joined using closed end pop rivets and joint sealant.
- C. Fabricate roofing and related sheet metal work in compliance with approved shop drawings and applicable standards. Form sheet metal work with clear, sharp, and uniform arrises. Hem exposed edges.
- D. Make joints in aluminum sheets using flat-lock seams, $\frac{3}{4}$ -inch in width. Fill seams with exterior sealant.
- E. Provide linear sheet metal items in minimum 10'-0" sections except as otherwise noted. Form flashing using single pieces for full width. Provide shop fabricated, mitered joints and corners, with minimum 2'-0" long legs.
- F. Clips:
 1. Provide UL listed clip designed to allow panels to thermally expand and contract.
 2. Fabricate clips with embossings that raise underside of panels above substrate to create positive ventilation and eliminate underside-condensation and corrosion.
 3. Fabricate clips with structurally embossed outstanding legs to prevent distortion due to wind uplift forces.

PART 3 - EXECUTION

3.1 DECK PREPARATION

- A. Install one layer of gypsum roof deck board and plywood to metal deck with approved noncorrosive mechanical fasteners spaced to meet wind uplift criteria.
- B. Butt gypsum roof deck board and plywood ends and sides together. Lay gypsum roof deck board and plywood so end joints occur over crests of steel roof deck with end joints staggered 2 feet in adjacent rows.
- C. Apply one layer of 30# felt over plywood and gypsum board deck substrates with horizontal overlaps and end laps staggered between layers.
 1. Lay felt parallel to ridge line with 2-1/2-inch horizontal laps and 6-inch vertical laps.

- D. On valleys and ridges and areas where ice and water may stand, install one layer of waterproof underlayment in compliance with manufacturer's printed instructions.
- E. Omit felt underlayment at areas of waterproof underlayment. Lap felt underlayment over waterproof underlayment as recommended by manufacturer, but not less than 2-inches.

3.2 ROOFING AND FLASHING INSTALLATION

- A. Inspection: Examine alignment and placement of building structure before proceeding with installation of preformed standing seam metal roofing.
- B. Install roofing and flashings in compliance with approved shop drawings and within specified erection tolerances.
- C. Isolate dissimilar metals and masonry or concrete from metals with bituminous paint, tape, or flexible flashing. Use gasketed fasteners where required to prevent corrosive action between fastener, substrate and panels.
- D. Use exposed fasteners, prefinished to match finish of panels and trim. Limit exposed fasteners to extent indicated on shop drawings.
- E. Anchorage shall allow for temperature expansion/contraction movement within specified range without stress or elongation of panels, clips or anchors. Attach clips to purlins, sleepers or track using self-drilling screws of size and spacing as determined by manufacturer's design analysis to resist specified uplift and thermal movement forces.
- F. Seal laps and joints in compliance with roofing system manufacturer's product data.
- G. Coordinate flashing and sheet metal work to provide weathertight conditions at roof terminations. Fabricate and install in compliance with standards of SMACNA "Architectural Sheet Metal Manual" and NRCA "Construction Details" using continuous cleats at all exposed edges.
- H. Provide for temperature expansion/contraction movement of panels at roof penetrations and roof mounted equipment as recommended by system manufacturer.
- I. Installed system shall be true to line and plane and free of dents, oilcans and physical defects.
- J. Form joints in linear sheet metal to allow for ½-inch minimum expansion at 12'-0" o.c. maximum and 2'-0" from corners. Provide 1'-0" wide back-up plate at intersections. Form plates to profile of sheet metal item.
- K. At joints in linear sheet metal items, set sheet metal over back-up plate in two beads of butyl sealant, ¼-inch in diameter, minimum. Extend sealant over all metal surfaces. Accurately mate components for positive seal. Allow no sealant to migrate onto exposed surfaces.

- L. Remove damaged work and replace with new, undamaged components.
- M. Applicable Erection Tolerances: Maximum variation from true planes and lines: ¼-inch in 20'-0", 3/8-inch in 40'-0" or more.

3.3 CLEANING

- A. Remove protective film and clean exposed surfaces of preformed roofing and accessories after completion of installation. Leave in clean condition at Date of Substantial Completion. Touch up minor abrasions and scratches in finish to satisfaction of Contracting Officer or authorized representative.

END OF SECTION 07610

SECTION 07841

THROUGH-PENETRATION FIRESTOP SYSTEMS

1.1 GENERAL

- A. Performance Requirements: Provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - a. Penetrations located outside wall cavities.
 - b. Penetrations located outside fire-resistive shaft enclosures.
 - c. Penetrations located in construction containing fire-protection-rated openings.
 - d. Penetrating items larger than 4-inch- (100-mm-) diameter nominal pipe or 16 sq. in. (100 sq. cm) in overall cross-sectional area.
 3. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
 - a. For piping penetrations for wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - b. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
 4. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.
- B. Submittals: In addition to Product Data for each type of product specified, submit the following:
1. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction.

2. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.
 3. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.
- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Paragraph:
1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 2. Through-penetration firestop systems are identical to those tested per ASTM E 814 and bear classification marking of qualified testing and inspecting agency.

1.2 PRODUCTS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following (or approved equal):
1. DAP Inc.
 2. Firestop Systems Inc.
 3. Hilti Construction Chemicals, Inc.
 4. RectorSeal Corporation (The).
 5. 3M Fire Protection Products.
 6. Tremco.
 7. United States Gypsum Company.
- C. Firestopping, General: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- D. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Paragraph. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
1. Permanent forming/damming/backing materials.
 2. Temporary forming materials.
 3. Substrate primers.

4. Collars.
 5. Steel sleeves.
- E. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of this Section by reference to the types of materials described below. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
1. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
 2. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
 3. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
 4. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
 5. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
 6. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
 7. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
 8. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants.

1.3 EXECUTION

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Paragraph and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Through-penetration firestop system designation of applicable testing and inspecting agency.

4. Date of installation.
 5. Through-penetration firestop system manufacturer's name.
 6. Installer's name.
- D. Through-Penetration Firestop System Schedule: Where UL-classified systems are indicated, they refer to the alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.
1. Firestop Systems for Metallic Pipes, Conduit, or Tubing FS-<#>: Comply with the following:
 - a. UL-Classified Systems: [C-AJ-] [C-BJ-] [C-BK-] [F-A-] [F-B-] [F-C-] [W-J-] [W-K-] [W-L-] <Insert one or more four-digit numbers> [1001-1999].

END OF SECTION 07841

SECTION 07920

JOINT SEALANTS

1.1 GENERAL

- A. Preconstruction Joint-Sealant-Substrate Tests: Submit substrate materials, representative of actual joint surfaces, to joint sealant manufacturer for laboratory testing of joint sealants for adhesion to primed and unprimed substrates and for compatibility with joint substrates and other joint-related materials.
- B. Submittals: In addition to Product Data, submit the following:
 - 1. Samples of each type and color of joint sealant required.
 - 2. Test reports for joint sealants evidencing compliance with requirements.

1.2 PRODUCTS

- A. Elastomeric Sealant Manufacturers: Subject to compliance with requirements, provide sealants by one of the following (or approved equal):
 - 1. Silicone Sealants:
 - a. Dow Corning.
 - b. GE Silicones.
 - c. NUCO Industries, Inc.
 - d. Sonneborn Building Products Div., ChemRex Inc.
 - e. Tremco.
 - 2. Urethane Sealants:
 - a. Polymeric Systems, Inc.
 - b. Sonneborn Building Products Div., ChemRex Inc.
 - c. Tremco.
- B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by testing and field experience.
- C. Colors: Provide colors indicated for exposed joint sealants or, if not indicated, as selected by Contracting Officer's Representative from manufacturer's full range for this characteristic.
- D. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant of base polymer specified below:

1. Low-Modulus Neutral-Curing Silicone Sealant: Type S, Grade NS, Class 25, and as follows:
 - a. Uses NT, G, A, and O.
 - b. Additional capability, when tested per ASTM C 719, to withstand the following percentage changes in joint width and still comply with other requirements of ASTM C 920:
 - 1) 100 percent movement in extension and 50 percent movement in compression for a total of 150 percent movement.
 - c. Applications: Window and door frames, thresholds and lintels.
 2. Medium-Modulus Neutral-Curing Silicone Sealant: Type S; Grade NS; Class 25; with the additional capability, when tested per ASTM C 719, to withstand 50 percent movement in both extension and compression for a total of 100 percent movement and still comply with other requirements of ASTM C 920; and as follows:
 - a. Uses NT, M, G, A, and O.
 - b. Application: Glazing.
 3. High-Modulus Neutral-Curing Silicone Sealant: Type S; Grade NS; Class 25; and as follows:
 - a. Uses NT, M, G, A, and O.
 - b. Applications: Galvanized steel and miscellaneous aluminum flashing.
 4. Mildew-Resistant Silicone Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and O; formulated with fungicide; intended for sealing interior joints with nonporous substrates exposed to high humidity and temperature extremes.
 5. Single-Component Nonsag Urethane Sealant: Type S; Grade NS; and as follows:
 - a. Class 25.
 - b. Uses NT, M, A, and O.
 - c. Applications: Exterior masonry joints.
- E. Latex Sealant: ASTM C 834.
- F. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834.
- G. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
- H. Sealant Backings, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- I. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Type O: Open-cell material.
- J. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C).
- K. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint.
- L. Primer: As recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

1.3 EXECUTION

- A. General: Comply with joint sealant manufacturer's instructions for products and applications indicated.
- B. Sealant Installation Standard: Comply with ASTM C 1193.
- C. Acoustical Sealant Application Standard: Comply with ASTM C 919 for use of joint sealants in acoustical applications.

END OF SECTION 07920

SECTION 08110

STEEL DOORS AND FRAMES

1.1 GENERAL

A. Submittals:

1. Product Data and Shop Drawings for each type of door and frame indicated.
2. Door Schedule using same reference designations indicated on Drawings in preparing schedule for doors and frames.

B. Quality Assurance:

1. Comply with ANSI A 250.8, unless more stringent requirements are indicated.

1.2 PRODUCTS

A. Materials:

1. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
2. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.
3. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with A40 (ZF120) zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.
4. Electrolytic Zinc-Coated Steel Sheets: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized; suitable for unexposed applications; stretcher-leveled standard of flatness where used for face sheets.

B. Interior and Exterior Doors: Doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 3 and Physical Performance Level A, Model 1 (Full Flush).

C. Frames: Provide steel frames that comply with ANSI A250.8 and with steel sheet thickness as indicated for door level selected below:

1. For Level 3 steel doors, 0.067 inch (1.7 mm).
2. Door Silencers: Three silencers on single-door frames and two silencers on double-door frames.
3. Supports and Anchors: Not less than 0.042-inch- (1.0-mm-) thick, zinc-coated steel sheet.

4. Wall Anchors in Masonry Construction: 0.177-inch- (4.5-mm-) diameter, steel wire complying with ASTM A 510 (ASTM A 510M) may be used in place of steel sheet.
 5. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.
- D. Fabricate steel door and frame units to comply with ANSI A250.8 and to be free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant.
1. Doors and Frames: Fabricate from metallic-coated steel sheet. Close top and bottom edges of doors flush.
 2. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards.
 3. Tolerances: Comply with SDI 117.
 4. Prepare doors and frames to receive hardware. Reinforce doors and frames to receive surface-applied hardware. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
 5. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints. Provide temporary spreader bars.
 6. Provide nonremovable glazing stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
 7. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.
- E. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

1.3 EXECUTION

- A. Install doors and frames according to Shop Drawings and manufacturer's data.
1. Frames: Install steel frames for doors and other openings, of size and profile indicated.
 - a. Provide at least three wall anchors per jamb. For openings 90 inches (2286 mm) or more in height, install an additional anchor at hinge and strike jambs.
 - b. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 2. Doors: Install to comply with ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:

- a. Jambs and Head: 1/8 inch (3.2 mm).
- b. Meeting Edges, Pairs of Doors: 1/4 inch (6.4 mm).
- c. Bottom: 3/4 inch (19 mm).

B. Adjusting and Cleaning:

- 1. Prime-Coat Touchup: Sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- 2. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 08110

SECTION 08711
DOOR HARDWARE

1.1 GENERAL

- A. Submittals: In addition to Product Data for each item specified, submit the following:
 - 1. Door Hardware Schedule: Organize into door hardware sets indicating type, style, function, size, label, hand, manufacturer, fasteners, location, and finish of each door hardware item.
- B. Supplier Qualifications: Door hardware supplier who is or employs a qualified DHI Architectural Hardware Consultant.
- C. Templates: Obtain and distribute templates for doors, frames, and other work specified to be factory prepared for installing door hardware.

1.2 PRODUCTS

- A. Scheduled Door Hardware: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in door and frame schedule.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
 - 2. Designations: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- B. Standards: Comply with BHMA A156 series standards, Grade 1, unless Grade 2 is indicated.
- C. Certified Products: Provide door hardware that is listed in one of BHMA's directories of certified products.
- D. Hinges and Pivots: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
 - 1. Hinge Base Metal: Unless otherwise indicated, provide the following:
 - a. Hinges: Stainless steel, with stainless-steel pin.
 - 2. Nonremovable Pins: Provide set screw in hinge barrel that prevents removal of pin while door is closed; for outswinging exterior doors and outswinging corridor doors with locks.
 - 3. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
 - 4. Screws: Phillips flat-head screws. Finish screw heads to match surface of hinges.

- E. Locks and Latches: As follows:
 - 1. Provide the lockset design designated below:
 - a. Bored Locks: Best; 9K Series, 14L or equal.
 - 2. Dummy Trim: Match lever lock trim and escutcheons.
 - 3. Lock Throw: Comply with labeled fire door requirements.
 - 4. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.
- F. Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
 - 1. Number of Pins: Six.
 - 2. High-Security Grade: BHMA Grade 1A, listed and labeled as complying with UL 437 (Suffix A).
 - 3. Manufacturer: Same manufacturer as for locks and latches.
 - 4. Permanent Cores: Manufacturer's standard; finish face to match lockset; removable cores.
 - 5. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
 - 6. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.
 - a. Replace construction cores with permanent cores, as directed by Owner.
- G. Keying System: Coordinate with Contracting Officer's Representative.
 - 1. Keys: Provide nickel-silver keys permanently inscribed with a visual key control number and "DO NOT DUPLICATE" notation. In addition to one extra blank key for each lock, provide three change keys and five master keys.
- H. Strikes: Manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.
- I. Closers: Comply with the following:
 - 1. Size of Units: Factory sized, adjustable to meet field conditions and requirements for opening force.
- J. Protective Trim Units: Furnish protection plates sized 1-1/2 inches (38 mm) less than door width on push side and 1/2 inch (13 mm) less than door width on pull side, by height specified in Door Hardware Schedule. Fasten with exposed machine or self-tapping screws.
- K. Floor Stops: For doors, unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
- L. Door Gasketing: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or

scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
2. Gasketing Materials: Comply with ASTM D 2000 and AAMA 701/702.

M. Fabrication: As follows:

1. Base Metals: Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials if different from specified standard.
2. Fasteners: Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated. Provide steel machine or wood screws or steel through bolts for fire-rated applications.
3. Spacers or Sex Bolts: For through bolting of hollow metal doors.
4. Fasteners for Wood Doors: Comply with requirements of DHI WDHS.2, "Recommended Fasteners for Wood Doors."

1.3 EXECUTION

- A. Examine doors and frames for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- B. Steel Door and Frame Preparation: Comply with DHI A115 series. Drill and tap doors and frames for surface-applied hardware according to SDI 107.
- C. Mounting Heights: Comply with DHI requirements, unless otherwise indicated.
- D. Installation: Comply with manufacturer's written instructions. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 1. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Adjust and check each operating item of door hardware and each door to ensure proper operation or function. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with accessibility requirements. Clean operating items as necessary to restore proper function and finish.
- F. Door Hardware Schedule: Provide products indicated (or approved equal) as follows:

1. Hardware Set No. 1
 - a. 1 ½ pair butts: Hager, Full Mortise BB1191, 4-1/2x4-1/2.
 - b. 1 Lockset: Best, 9K Series, 14L, AB-Entrance.
 - c. 1 Closer: Parallel arm, LCN, 1460 series.
 - d. 1 set Weatherstripping: Reese, DS75D.
 - e. 1 Sill Sweep: Reese, 362D.
 - f. 1 Threshold: Reese S475A.

2. Hardware Set No. 2
 - a. 3 pair butts: Hager, Full Mortise BB1191, 4-1/2x4-1/2.
 - b. 1 Lockset: Best, 9K Series, 14L, D-Storeroom.
 - c. 1 Dummy Trim.
 - d. 1 set Flush Bolts: Glynn-Johnson, FB6.
 - e. 1 Astragal: Reese, 393D.

END OF SECTION 08711

SECTION 09900

PAINTING

1.1 GENERAL

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Contracting Officer or Authorized Representative will select from standard colors and finishes available.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- D. Submittals: For each paint system specified, provide the following:
 - 1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
- E. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- F. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.
- G. 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 in clean condition, free of foreign materials and residue. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

- H. Project Conditions: Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.2 PRODUCTS

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- C. Colors: Provide color selections made by the Contracting Officer's Representative.

1.3 EXECUTION

- A. Examine substrates, areas, and conditions under which painting will be performed for compliance with paint application requirements. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates.
- C. Preparation: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- D. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- E. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
 - 1. Cementitious Materials: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

- a. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
 - a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
 3. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- F. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 2. Use only thinners approved by paint manufacturer and only within recommended limits.
- G. Application: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in items are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 7. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 8. Sand lightly between each succeeding enamel or varnish coat.
- H. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- I. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
- J. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- K. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- M. Field Quality Control: The Government reserves the right to engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.
1. The testing agency will perform appropriate tests as required by the Government.
 2. If tests show material being used does not comply with specified requirements, the Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.
- N. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

- O. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Contracting Officer or Authorized Representative.
- P. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

1.4 PAINT SCHEDULE

- A. Concrete Masonry Units: Provide the following finish systems over interior concrete masonry block units:
 - 1. Low-Luster, Acrylic-Enamel Finish: Two finish coats over a block filler.
 - a. Block Filler: High performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 5.0 mils.
 - b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
- B. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - 1. Low-Luster, Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
 - b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
- C. Zinc-Coated Metal: Provide the following finish systems over zinc-coated metal:
 - 1. Low-Luster, Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
 - b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by manufacturer to achieve a total dry film thickness of not less than 2.8 mils.

- D. All exposed equipment shall be painted as per Seymour Johnson AFB color standard, coordinate color with the Contracting Officer or authorized representative.
 - 1. Low-Luster, Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.

END OF SECTION 09900

SECTION 13916

FIRE-SUPPRESSION SPRINKLERS

1.1 GENERAL

- A. Design sprinkler working plans and obtain approval from contracting officer's representative.
- B. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction:
 - 1. Include 10 percent margin of safety for available water flow and pressure.
 - 2. Sprinkler Occupancy Hazard Classifications: As follows:
 - a. Hangar Areas: Special Hazard Occupancy.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design: As follows:
 - a. Special Hazard Occupancy: 0.20 gpm/sq. ft. over 5,000-sq. ft. (12.6 mL/s over 467-sq. m) area.
 - 4. Maximum Protection Area per Sprinkler: As follows:
 - a. Hangar Areas: 100 sq. ft. (9.3 sq. m).
- C. Components and Installation: Capable of producing piping systems with 175-psig (1200-kPa) minimum working-pressure rating.
- D. Submittals: Submit the following:
 - 1. Product Data: For valves (OS&Y, wet alarm check), piping materials, couplings, and fittings, hangers and upper attachments, pressure switches, tamper switch, and all sprinkler head types.
 - 2. Warranty: provide manufacturer's written warranty for pipe, pipe fittings, pipe couplings, and sprinkler heads.
 - 3. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction.
 - 4. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping", purging and disinfecting reports, and hydrostatic tests.
 - 5. Provide operating instructions for the alarm valves.
- E. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.

- F. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction. All components of sprinkler system installed as part of this contract shall be by the same manufacturer.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- H. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:
 1. NFPA 13-1999, "Standard for the Installation of Sprinkler Systems."
 2. NFPA 409-1995 "Standard for Aircraft Hangars."

1.2 PRODUCTS

- A. Piping: Refer to "Piping Applications" Paragraph for applications of pipe, tube, fitting, and joining materials.
- B. Standard-Weight Steel Pipe: Black steel and galvanized, ASTM A 53, ASTM A 135, or ASTM A 795; Schedule 40 in NPS 6 (DN150) and smaller, and Schedule 30 in NPS 8 (DN200) and larger.
- C. Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30 or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe. Thinwall pipe (schedule 5, 7, and 10) and threadable thinwall pipe (less than schedule 40) shall not be used.
- D. Cast-Iron Threaded Flanges: ASME B16.1.
- E. Cast-Iron Threaded Fittings: ASME B16.4.
- F. Malleable-Iron Threaded Fittings: ASME B16.3.
- G. Steel, Threaded Couplings: ASTM A 865.
- H. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.
- I. Steel Flanges and Flanged Fittings: ASME B16.5.
- J. Steel, Grooved-End Fittings: UL-listed and FM-approved, ASTM A 47 (ASTM A 47M), malleable iron or ASTM A 536, ductile iron; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.
- K. Fire-Protection-Service Valves: UL listed and FM approved, with minimum 175-psig (1200-kPa) nonshock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.
 1. Gate Valves, NPS 2 (DN50) and Smaller: UL 262; cast-bronze, threaded ends; solid wedge; OS&Y; and rising stem.

2. Indicating Valves, NPS 2-1/2 (DN65) and Smaller: UL 1091; ball-type, bronze body with threaded ends; and integral indicating device.
 3. Gate Valves, NPS 2-1/2 (DN65) and Larger: UL 262, iron body, bronze mounted, taper wedge, OS&Y, and rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.
 4. Swing Check Valves, NPS 2 (DN50) and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.
 5. Swing Check Valves, NPS 2-1/2 (DN65) and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.
- L. Alarm Check Valves: UL 193, 175-psig (1200-kPa) working pressure, designed for horizontal or vertical installation, with cast-iron flanged inlet and outlet, or grooved outlet, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, retarding chamber, fill-line attachment with strainer, and drip cup assembly.
- M. Automatic Sprinklers: With heat-responsive element complying with the following:
1. UL 199, for applications except residential.
- N. Sprinkler Types and Categories: Nominal 1/2-inch (12.7-mm) orifice for "Intermediate" temperature classification rating (175°F), with nominal discharge coefficient "k" of 5.6, unless otherwise indicated or required by application.
- O. Sprinkler types, features, and options include the following:
1. Upright sprinklers.
- P. Sprinkler Finish: Bronze.
- Q. Specialty Sprinkler Fittings: UL listed and FM approved; made of steel, ductile iron, or other materials compatible with piping.
- R. Locking-Lug Fittings: Unacceptable.
- S. Mechanical-Cross Fittings: UL 213, ductile-iron housing with pressure-responsive gaskets, bolts, and threaded or grooved outlets.
- T. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
- U. Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch- (90- to 115-mm-) diameter dial with dial range of 0 to 250 psig (0 to 1725 kPa).

1.3 EXECUTION

- A. Preparation: Fire-suppression flow is indicated on Drawing F1 Note 5. Use results for system design calculations. Any additional tests shall be performed by base personnel.
- B. Piping Applications: Use according to the following:
 - 1. Do not use welded joints with galvanized steel pipe.
 - 2. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
 - 3. Sprinkler Feed Mains and Risers: Use the following:
 - a. NPS 4 (DN100) and Larger: Standard-weight steel pipe with threaded ends, cast or malleable iron threaded fittings, and threaded joints.
 - b. NPS 4 (DN100) and Larger: Standard-weight steel pipe with grooved ends, steel grooved end fittings, steel, keyed couplings, and grooved joints.
 - c. NPS 4 (DN100) and Larger: Standard-weight steel pipe with plain ends, steel welding fittings, and welded joints.
 - d. NPS 4 (DN100) and Larger: Schedule 40 steel pipe with threaded ends, cast or malleable iron threaded fittings, and threaded joints.
- C. Valve Applications: Paragraph 1.2.K indicates valve types to be used. Where specific valve types are not indicated on drawings, the following requirements apply:
 - 1. Fire-Protection-Service Valves: UL listed and FM approved for applications where required by NFPA 13.
 - a. Shutoff Duty: Use gate valves.
 - 2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 13.
 - a. Shutoff Duty: Use gate valves.
- D. Joint Construction:
 - 1. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut-grooved ends and Schedule 30 pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
 - 2. Locking-Lug-Fitting, Twist-Locked Joints: Unacceptable.
- E. Piping Installation:
 - 1. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical. Deviations from approved working plans for piping require written

- approval from contracting officer's representative. File written approval before deviating from approved working plans.
2. Install underground service entrance piping according to NFPA 24 and with restrained joints.
 3. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
 4. Install unions adjacent to each valve in pipes NPS 2 (DN50) and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
 5. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 (DN65) and larger connections.
 6. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to sprinkler risers when sprinkler branch piping is connected to sprinkler risers.
 7. Install flow alarm devices in piping systems and tamper switches on valves.
 8. Hangers and Supports: Comply with NFPA 13 for hanger materials and installation. All hangers and upper attachments shall be UL listed and FM approved.
 9. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.
- F. Valve Installation: Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13, manufacturer's written instructions, and authorities having jurisdiction.
1. Gate Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.
 2. Install check valve in each water supply connection.
 3. Alarm Check Valves: Install valves in vertical position for proper direction of flow, including bypass check valve and retard chamber drain-line connection.
- G. Sprinkler Applications: Use sprinklers according to the following:
1. Hangar Spaces: Upright.
 2. Sprinkler Finishes: Use sprinklers with the following:
 - a. Upright Sprinklers: Rough Bronze in all spaces.
- H. Sprinkler Installation: remove existing heads and verify thread pattern and orifice size prior to ordering new heads. Replace all existing open heads with new closed heads of same orifice size and thread pattern. All new sprinkler heads shall be of the same manufacturer.
- I. Connect piping to specialty valves, specialties, and accessories.
- J. Electrical Connections: Power wiring is specified in Division 16.
- K. Connection of alarm devices to new fire alarm system will be performed by Division 16. See electrical drawings and specifications.

- L. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13. This includes hydraulic design information sign.
- M. Flush, test, and inspect new and existing sprinkler piping according to NFPA 13, "System Acceptance" Chapter. New and existing sprinkler piping shall be chlorinated per NFPA 13 and solution concentration and duration adjusted to suit piping material being flushed.

END OF SECTION 13916

SECTION 13956

HIGH EXPANSION FOAM (HI-X FOAM) FIRE PROTECTION SYSTEM

PART 1 - GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR FORCE ENGINEERING TECHNICAL LETTER (ETL)

ETL 01-2 (2001) Fire Protection Engineering Criteria - New Aircraft Facilities

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1 (1996) Scheme for the Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47 (1990; R 1995) Ferritic Malleable Iron Castings

ASTM A 53 (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 183 (1983; R 1990) Carbon Steel Track Bolts and Nuts

ASTM A 312/A 312M (1995a) Seamless and Welded Austenitic Stainless Steel Pipes

ASTM A 351/A 351M (1994a) Castings, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts

ASTM A 403/A 403M (1996) Wrought Austenitic Stainless Steel Piping Fittings

ASTM A 536 (1984; R 1993) Ductile Iron Castings

ASTM A 795 (1996) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1 (1989) Cast Iron Pipe Flanges and Flanged Fittings

ASME B16.3 (1992) Malleable Iron Threaded Fittings

ASME B16.4 (1992) Gray Iron Threaded Fittings

ASME B16.21 (1992) Nonmetallic Flat Gaskets for Pipe Flanges

ASME BPV VIII Div 1 (1995; Addenda Dec 1995, Dec 1996) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a (1998) Approval Guide Fire Protection

FM P7825b (1998) Approval Guide Electrical Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC Power Circuits

MILITARY SPECIFICATIONS (MS)

MS MIL-F-24385 (Rev F; Am 1) Fire Extinguishing Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate, For Fresh and Sea Water

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 11A (1999) Medium and High Expansion Foam Systems

NFPA 13 (1999) Automatic Sprinkler Systems

NFPA 16 (1999) Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems

NFPA 70 (2002) National Electrical Code

NFPA 72 (1999) National Fire Alarm Code

NFPA 409 (1995) Standard on Aircraft Hangars

NFPA 1963 (1993) Fire Hose Connections

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir (1997) Fire Protection Equipment Directory

1.2 GENERAL REQUIREMENTS

The system shall consist of an automatic high expansion foam-water supplemental under wing fire protection system and shall be provided for the areas indicated on the drawings. Except as modified herein, the system shall meet the requirements of NFPA 11A, NFPA 13, NFPA 16-1999

A. Control System

The control system shall meet the requirements of NFPA 72. The control panel shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b for "Releasing Device Service". The control panel and the solenoid valve which activates the

water control valves shall be compatible with each other. Compatibility shall be per specific UL listing or FM approval of the control equipment.

B. Power Supply

The primary operating power shall be provided from two single phase 120 VAC circuits. Transfer from normal to backup power and restoration from backup to normal power shall be fully automatic and not cause a false alarm. Loss of primary power shall not prevent actuation of the respective automatic water control valve upon activation of any alarm initiating device. Backup power shall be provided through use of rechargeable, sealed, lead calcium storage batteries.

C. Circuit Requirements

Except as modified herein, alarm initiating devices shall be connected to initiating device circuits (IDC) or signal line circuits (SLC) in accordance with NFPA 72. Where five or more initiating devices are connected to an IDC or an SLC, the arrangement shall be capable of transmitting an alarm signal during a single open or a nonsimultaneous single ground fault on a circuit conductor (Class A). Alarm notification appliances shall be connected to notification appliance circuits (NAC), in accordance with NFPA 72. A separate circuit shall be provided for actuation of each individual automatic water control valve. The circuits that actuate the water control valves shall be fully supervised so that the occurrence of a single open or a single ground fault condition in the interconnecting conductors shall be indicated at the control panel.

1.3 SYSTEM OPERATIONAL FEATURES

The single-interlocked under wing high expansion system shall operate such that actuation of a manual release will cause the automatic water control (deluge) valves for generators to open, foam concentrate to enter the proportioner, and foam-water solution to be discharged from the generator system. The ceiling suppression system is existing, wet only.

A. HYDRAULIC DESIGN

The ceiling wet system shall be hydraulically designed to discharge a minimum density of 0.20 GPM per sq. ft. (0.08 L/Min. per sq. mtr.) over hydraulically most remote 5,000 sq. ft. (465 sq. mtr.) Hydraulic calculations shall conform with the area/density method of NFPA 13. Add to the wet sprinkler system demand an additional 1515 GPM (5740 L/Min) for operating under wing HI-X foam generators.

B. HIGH EXPANSION FOAM (HI-X FOAM) DESIGN

The HI-X foam system shall be designed for a 2 ¾% concentrate to be applied during a 15-minute period. Additionally, the HI-X foam system shall be designed to provide coverage under 90% of the aircraft shadow in one minute or less and to a depth of 1 (one) meter in four minutes or less for the entire servicing area. The total rate of discharge shall not be less than 2.6 cfm / sq. ft. (0.8 m³/min / m²) and shall be within the range of 2.6 to 4.0 cfm / sq. ft. (0.8 to 1.2 m³/min / m²).

1.4 SUBMITTALS

- A. Product Data for HI-X Foam System Equipment: Manufacturer's catalog data for each separate piece of equipment proposed for use in the system. Data shall indicate the name of the manufacturer of each item of equipment, with data highlighted to indicate model, size, options, etc. proposed for installation. In addition, a complete equipment list with equipment description, model number, and quantity shall be provided. Submit data for the following equipment and devices: pipe, pipe fittings, pipe couplings, control valves, alarm valves, deluge valves, alarm devices (pressure switches, flow switches, tamper switches) proportioning valve, HI-X foam concentrate, bladder tank, test header, HI-X foam generators, and hangers.
- B. Spare Parts: Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.
- C. Shop Drawings: HI-X Foam System: Detail drawings shall conform to the requirements prescribed in NFPA 13 and shall be 24x36 inches. Drawings shall include plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:
1. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
 2. Floor plans drawn to a scale not less than 1/8 inch equals 1 foot clearly showing locations of devices, equipment, risers, electrical power connections, areas covered by each generator, and other details required to clearly describe the proposed arrangement.
 3. Piping plan for each generator system. Generators and associated piping shall be shown. Abbreviated presentation forms will not be accepted. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be identified. A separate plan shall be provided for each generator system.
 4. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; and from sprinkler feed mains, crossmains and branchlines to finished floor and roof or ceiling.
 5. Location of control panels, detectors, manual stations, supervisory switches, solenoids, notification appliances, and other electrical devices. In addition, conduit routing and sizes, and the number of conductors contained in each shall be indicated.
 6. HI-X Foam Equipment room layout drawings drawn to a scale of not less than 1/2 inch equals 1 foot to show details of each system component, clearances between each other and from other equipment and construction in the room.

7. Details of each type of pipe hanger, proportioners, generators and mounting details, HI-X Foam system control valve header and related components.
 8. Connection drawings and control diagrams indicating overall electrical and mechanical operation of the HI-X Foam system. This shall include identification and operation of each major component of the system. Diagrams shall be supplemented with a narrative description of the system. Point-to-point wiring diagrams shall indicate control panel wiring and make and model of devices and equipment connected thereto.
- D. As-Built Drawings: One set of reproducible and six copies, within 14 calendar days after successful completion of required testing. A separate set of approved submittal drawings of the overall system, marked up to indicate as-built conditions, shall be maintained on site. These drawings shall be maintained in a current condition at all times and shall be made available for review immediately upon request during normal working hours. Variations from the approved drawings, for whatever reason, including those occasioned by modifications, change orders, optional materials, and/or required for coordination between trades shall be indicated in sufficient detail to accurately reflect the as-built conditions.
- E. Contractor Qualifications: Design and Construction Qualifications:
1. Fire Protection Engineer Qualifications:

It is mandatory that the design shall be performed by a qualified Fire Protection Engineer (whether the design is accomplished in house or through an outside A-E Firm), experienced in the design of aircraft hangars, for the design of the fire protection systems for this project. The design shall be based upon the accompanying design criteria drawings and specifications. Qualified Fire Protection Engineer does not have a universal definition and is defined differently among various governmental agencies. One of the following credentials is required to meet the criteria for qualified Fire Protection Engineer.

Bachelor of Science or Master of Science Degree in fire protection engineering from an accredited university, plus a minimum of five years work experience in fire protection engineering.

Professional Engineer (PE) registration by examination, National Council of Examiners for Engineering and Surveys (NCEE) fire protection engineering written examination.

Qualification as a GS/GM 804-series fire protection engineer.

Professional Engineer (PE) registration in a related discipline with a minimum of five years work experience in fire protection engineering.

The A-E Firm will confirm that: The designer complies with the definition of "qualified fire protection engineer" above; and that the fire protection engineer has substantial experience in the design and construction of aircraft hangar fire protection systems of similar complexity.

F. SUBMITTAL PREPARERS QUALIFICATIONS

The sprinkler system submittals, including working drawings, as-built drawings, and hydraulic calculations shall be prepared by a qualified fire protection professional engineer.

G. INSTALLER QUALIFICATIONS

The installer shall be experienced and regularly engaged in the installation of the type and complexity of system included in this project. A statement prior to submittal of any other data or drawings, that the proposed system installer is regularly engaged in the installation of the type and complexity of system included in this project shall be provided. In addition, data identifying the location of at least three systems recently installed by the proposed installer which are comparable to the system specified shall be submitted. Contractor shall certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months.

H. Final Acceptance Test Plan: Details of method proposed for required tests at Final Acceptance, including step-by-step procedures; list of equipment to be used; names, titles, and affiliations and qualifications of personnel who will participate in the tests; methods for protecting the facility and equipment during testing; means for containing the HI-X Foam solution during discharge tests; and proposed means for disposal. Blank forms the Contractor plans to use to record test results shall be included.

I. Reports: Reports for tests, as follows:

1. Reports as outlined in NFPA 13 documenting results of flushing and hydrostatic tests.
2. Trip tests of alarm valves and deluge valves.
3. Test report of HI-X Foam concentrate proportioning system. Report shall include conductivity readings for Foam samples taken from each HI-X Foam proportioner. Report shall be signed by the factory-trained technical representative employed by the HI-X Foam concentrate manufacturer.
4. Test report of the control panel and initiating and indicating devices comprising the entire release system. Report shall include a unique identifier for each device with an indication of test results. Report shall be signed by the factory-trained technician of the control panel manufacturer.
5. Videotapes of tests specified to be recorded.

J. Certificates: Contractor's Material and Test Certificates:

Certificates from manufacturers to substantiate that components, equipment and material proposed for installation and use meet requirements as specified, concurrent with submittal of manufacturer's catalog data of equipment proposed for installation.

Certificates shall be on a form for this purpose or on official letterhead of the manufacturer with specified information stated as required. Certificate shall be signed by an officer of the corporation. Certificates shall be provided for the following:

1. HI-X Foam concentrate. Certification that HI-X Foam concentrate proposed for use has been tested and is in compliance with MS MIL-F-24385.
2. HI-X Foam concentrate control valve. Certification that valve is designed, constructed and will function as specified.
3. Control Panel. Certification that the control panel releasing module is electrically compatible with the electrically-actuated solenoid valves.

K. Operation and Maintenance Manuals: HI-X Foam System:

Manuals in loose-leaf binder format and grouped by technical sections consisting of manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. The manuals shall list routine maintenance procedures, possible breakdowns, and repairs, and troubleshooting guide. The manuals shall include equipment layout for the system as installed. The manuals shall include procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

1.5 REGULATORY REQUIREMENTS

The advisory provisions of NFPA standards and recommended practices specified shall be considered mandatory, as though the word "shall" had been substituted for "should" wherever it appears. In the event of a conflict between referenced NFPA standards and this specification, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

PART 2 - PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 REQUIREMENTS FOR FIRE PROTECTION SERVICE

All equipment and material shall have been tested by Underwriters Laboratories, and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall

mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.

2.3 PRESSURE RATINGS

Valves, fittings, couplings, proportioners, alarm switches, strainers, and similar devices shall be rated for the maximum working pressures that can be experienced in the system, but in no case less than 175 psi.

2.4 NAMEPLATES

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate permanently affixed to the item of equipment. This same information shall be included in manual described in Section 1.4 K.

2.5 ABOVEGROUND PIPING SYSTEMS HANDLING WATER OR HI-X FOAM SOLUTION

A. Pipe

Pipe shall be standard weight black steel conforming to ASTM A 795 or ASTM A 53. Pipe 10 inch diameter and smaller shall be Schedule 40. Pipe shall be marked as to the brand or name of the manufacturer, kind of pipe and the ASTM designation in accordance with the "Product Marking" provisions of the ASTM standard. Galvanized pipe shall not be used. Thinwall pipe (schedule 5, 7, and 10) and threadable thinwall (less than schedule 40) shall not be used.

B. Non-Grooved Fittings

Non-grooved fittings shall be threaded or flanged. Threaded fittings shall be cast iron conforming to ASME B16.4 or malleable iron conforming to ASME B16.3. Flanged fittings shall be cast iron conforming to ASME B16.1. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings which require drilling a hole in the pipe, and fittings which use steel gripping locking lug devices to bite into the pipe shall not be used.

C. Grooved Fittings and Couplings

Grooved fittings, couplings and bolts shall be provided by the same manufacturer. Fittings and couplings shall be malleable iron complying with ASTM A 47 or ductile iron complying with ASTM A 536. Couplings shall be of the rigid type except that flexible type will be permitted where flexible joints are specifically required by NFPA 13. Coupling gaskets shall be approved for dry pipe fire protection service. Gasket shall be the flush type that fills the entire cavity between the coupling and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated. Gasket material shall be compatible with HI-X Foam concentrates.

D. Flanges and Gaskets

Flanges shall conform to NFPA 13 and ASME B16.1. Flanges shall be the type that are welded or threaded to the pipe. Flanges which are bolted to grooved pipe will not be permitted. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. Gasket material shall be compatible with HI-X Foam concentrates.

E. Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and be of the type suitable for the application, construction and size pipe involved.

F. Control Valve

Valves shall be indicating type in accordance with NFPA 13. Valves 2-1/2 inch and larger shall be flanged outside screw and yoke (OS&Y) type.

G. Check Valve

Check valves 4 inches and larger shall be flanged, swing type, cast or ductile iron body and cover, cast or ductile iron clapper with replaceable EPDM rubber facing. Facing material shall be compatible with HI-X Foam concentrates. Valves shall be suitable for either vertical or horizontal mounting and equipped with a removable handhole cover. The direction of flow shall be indicated by an arrow cast in the valve body. The valve body shall include plugged pipe thread connections for a 2 inch drain.

2.6 ABOVEGROUND PIPING SYSTEMS HANDLING HI-X FOAM CONCENTRATE

A. Pipe

Pipe shall be standard weight stainless steel conforming to ASTM A 312/A 312M, Grade TP 304L.

B. Fittings

Fittings shall be seamless socket weld type or flanged type and of material conforming to ASTM A 403/A 403M, Grade WP 304L, and shall be compatible with pipe.

C. Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and be of the type suitable for the application, construction and size pipe involved.

D. Control Valves

Valve shall be full port ball type with operating handle that indicates the on/off position of the valve. Unit shall be socket weld or flanged type. Valve body and ball shall be of 316 stainless steel complying with ASTM A 351/A 351M.

2.7 ALARM CHECK VALVE ASSEMBLY

Alarm check valve assembly shall be of the variable pressure type. Assembly shall be rated for not less than 175 psi. Assembly shall be provided with standard trimmings including pressure gauges, retarding chamber, alarm line vent, testing bypass, and necessary pipe, fittings, and accessories required for a complete installation. Alarm valve trim shall have separate valves for "alarm test" and "alarm shutoff."

2.8 AUTOMATIC WATER CONTROL VALVE ASSEMBLY (DELUGE VALVE)

Water control valve shall be an electrically-actuated latching type. Valve shall be externally resettable without opening the valve. Electrical solenoid valve used to actuate the water control valve shall be an integral component of the valve or shall be approved for use by the water control valve manufacturer and the control panel manufacturer. Solenoid valve shall be of the normally closed, de-energized type which opens when energized upon receipt of an electrical signal from the control panel to which it is connected. Water control valve shall be equipped with a means to prevent the valve from returning to the closed position until being manually reset. Assembly shall be complete with the valve manufacturer's standard trim piping, drain and test valves, pressure gauges, and other required appurtenances. Device shall be a standard accessory component of the valve manufacturer and shall be labeled as to its function and method of operation. Valves located in hazardous locations shall be approved for the hazard classification of the area where located. Deluge valves used for generator control shall be approved for horizontal installation if required.

2.9 ALARM DEVICES

A. Waterflow Pressure Alarm Switch

Unit shall include a 1/2 inch NPT male pipe thread, two 1/2 inch conduit knockouts, and two sets of SPDT (Form C) contacts. The switches shall be factory adjusted to transfer the contacts at 4 to 8 psi on rising pressure. Unit shall include a water-tight NEMA 4 diecast aluminum housing with a tamper resistant cover which requires a special key for removal. The cover shall be provided with a tamper switch which shall operate upon removal of the cover. Units used on wet-pipe systems shall have an adjustable, instantly recycling pneumatic retard to prevent false alarms due to water pressure variation. Retard adjustment shall be factory set at approximately 20-40 seconds and adjustable between 0-90 seconds.

B. Vane-type Waterflow Switch Assembly

Assembly shall consist of a cast aluminum pipe saddle housing an electro-mechanical device to which is attached a flexible, low-density polyethylene paddle. The paddle shall conform to the inside diameter of the fire protection pipe and sense water or solution movements. The waterflow indicator shall be capable of detecting a sustained flow exceeding 10 gpm. Assembly shall contain a pneumatic retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The unit shall include two sets of SPDT (Form C) contacts. The unit shall be equipped with a silicone

rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

C. Valve Supervisory (Tamper) Switch

Switch shall be designed to monitor the open condition of each water or HI-X Foam concentrate control valve to which it is mounted. The switch shall include a cast aluminum housing, tamperproof cover, two sets of single pole, double throw (SPDT) contacts and brackets and J-bolts needed for mounting. Removal of the cover shall cause both switches to operate.

2.10 BASKET STRAINER

Unit shall have cast iron flanged body and cover flanges. The strainer basket shall be formed of perforated stainless steel sheet with 1/4 inch perforations. Strainer size shall be 6 inch (150 mm) and shall have a maximum friction loss of 4 psi at a flow rate of 126 L/second 2000 gpm. Assembly shall allow access to the strainer basket by removing the flange on the top of the strainer.

2.11 DISCHARGE DEVICES

A. High Expansion Foam Generator Assembly

Assembly shall include water-powered generator, roof intake, roof curb, damper with operator and related ancillary components which all shall be the product of one manufacturer. Components in contact with the HI-X Foam solution shall be compatible with the Foam concentrate and metallic components shall be brass, bronze or stainless steel. The foam generator shall be powered by a water reaction motor (non-electric). The water reaction motor shall provide both the screen wetting solution and the energy to drive the fan. Generator shall be designed for fixed installations and shall be equipped with a stainless steel screen for maximum reliability under fire conditions. Generator shall be capable of being used in a balanced pressure proportioner system utilizing a bladder tank in a total flooding design application. Generator shall be a standard model of the manufacturer and shall have a fixed discharge characteristic. Generator discharge characteristic shall have been determined by tests by Underwriter's Laboratory or Factory Mutual. Minimum discharge characteristics at 50 psi inlet pressure: 13,880 cfm (393 m³/m) with a solution flow of 119 gpm (450 Lpm). Expansion volume ratio at above stated flow shall be a minimum of 870 to 1. Generator assembly shall be approved by Underwriter's Laboratory and listed in FM P7825a and FM P7825b. Each generator shall have been tested by the manufacturer or Factory Mutual to determine the foam volume generation range at various inlet pressures. Tests shall be made using a minimum of three generator pressures.

2.12 HI-X FOAM LIQUID CONCENTRATE

HI-X Foam concentrate shall be 2 3/4 percent and shall be listed/approved for use with the foam generators installed. Concentrate shall be the product of one manufacturer. Mixing of non-identical brands of concentrate will not be permitted.

2.13 DIAPHRAGM TANK BALANCED PRESSURE PROPORTIONING SYSTEM

Tank shall be a steel pressure vessel constructed in accordance with ASME BPV VIII Div 1. ASME label shall be permanently affixed to the tank. Tank shall be horizontally mounted on steel saddles and shall contain a full internal diaphragm (bladder) having a minimum capacity of 700 gallons. Diaphragm shall be nylon-reinforced Buna-N rubber or other approved material conforming to the inside shape of the tank. HI-X Foam concentrate shall be stored inside the diaphragm and the concentrate shall not be in contact with the steel tank. The tank shall have perforated PVC tubes installed inside the diaphragm to assure full displacement of the stored concentrate. Tank shall be equipped with the manufacturer's standard fittings and trim, including HI-X Foam fill and drain connections, water fill and drain connections, and concentrate sight gauge.

2.14 BALANCED PRESSURE PROPORTIONER (RATIO CONTROLLER)

The proportioner shall be a standard balanced pressure type unit capable of proportioning HI-X Foam liquid at 2 3/4 percent, (2 3/4 parts concentrate to 97 1/4 parts water by volume solution) at flow rates within the flow range of the proportioner. Proportioner shall be designed for use with bladder tank. Major components of the proportioner, including the body, inlet generator and metering orifice shall be of brass, bronze or stainless steel. The body shall be clearly marked with a flow-direction arrow, and the type and percent of HI-X Foam concentrate that it was designed to proportion. The proportioner size shall be 6 inch and shall have a maximum friction loss of 6 psi at a flow rate of 2000 GPM. The proportioner assembly shall be factory assembled and tested as an assembly by one manufacturer. Field disassembly or assembly of any component part will not be accepted. Components shall be of the make/model required by the specific UL listing or FM approval and shall be compatible with concentrate used.

2.15 HI-X FOAM CONCENTRATE CONTROL VALVE ASSEMBLY

Assembly shall control HI-X Foam concentrate to proportioners and shall be arranged to open upon application of water or HI-X Foam solution pressure from the alarm check or solenoid valve to which it is connected. Assembly shall include a full port ball valve, actuating cylinder, wye strainer at the water inlet port and an actuating cylinder vent valve. Valve components shall be brass, bronze or stainless steel. Valve shall be operable with water inlet pressure as low as 30 psi.

2.16 FOAM SYSTEM CONTROL PANEL

Panel shall be UL listed or FM approved for "Releasing Device Service" or shall have modules approved for this purpose. Panel shall contain components and equipment required to provide the specified operational and supervisory functions of the system. Components shall be housed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly factory assembled and wired unit. Panel shall include integral "power on," "alarm," and "trouble" lamps with

annunciation of each alarm, supervisory and trouble signal. The panel shall have prominent rigid plastic or metal identification plates for zones, indicating lights, controls, meters, and switches. Lamps and fuses mounted on circuit boards shall be identified by permanent markings on the circuit board. Nameplates for fuses shall also include ampere rating. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices (meter and lamps). Meters and lamps shall be plainly visible when the cabinet door is closed. Signals shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Upon restoration of power, start-up shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals.

A. Zone Annunciator

Visual annunciators shall be provided for each active zone and spare zone. A separate alarm and trouble lamp shall be provided for each zone and shall be located on exterior of the cabinet door or be visible through the door. A minimum of one spare alarm zone that are fully operational shall be provided. Each lamp shall provide specific identification of the zone by means of a permanently attached rigid plastic or metal sign with either raised, engraved or silk-screened letters. Zone identification shall consist of a unique zone number as well as a word description of the zone.

B. System Zoning

The system shall be zoned as follows:

<u>ZONE NO.</u>	<u>DESCRIPTION</u>
1	Hangar Hi-X Foam

C. Primary Power Supply

Primary power and trouble alarm power to Control Panel shall be supplied from two 120 VAC circuits. Power to the control panel shall be as indicated. Panel shall be equipped with two 20-amp circuit breakers for each control panel and with key lock. Disconnect switch shall be permanently marked "FOAM FIRE PROTECTION SYSTEM".

D. Emergency Power Supply

Emergency power shall be provided for system operation in the event of failure of the primary power supply and shall consist of rechargeable storage battery system. Transfer from normal to emergency power or restoration from emergency to normal power shall be automatic and shall not cause transmission of a false alarm.

1. Storage Batteries

Storage Batteries shall be sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary

power disconnected, to operate the system for a period of 90 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate alarm indicating devices in the alarm mode for a minimum period of 15 minutes. Battery cabinet shall be a separate compartment within the control panel. The battery compartment or cabinet shall have twice the volume of the batteries. Batteries shall set on a noncorrosive and nonconductive base or pad. Batteries in the control panel shall be located at the bottom of the panel.

2. Battery Charger

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 ammeter shall be provided for indicating rate of charge. A separate voltmeter shall be provided to indicate the state of the battery charge. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly if a high rate switch is provided. Charger shall be located in control panel cabinet.

2.17 MANUAL ACTUATION STATION

Unit shall be dual-action type requiring the lifting of a clear plastic cover and pulling of a ring to actuate. It shall not require the breaking of glass to actuate. Unit shall be painted lime yellow and include a cast or engraved label indicating "Start Foam System" with operating instructions clearly marked on the station cover. Alarm contacts shall have a minimum rating of 120 VAC, 60 Hz, 6 amps. Contact gap distance shall be factory set and not be field adjustable. Unit shall be compatible with the control panel to which it is connected. Unit shall be listed or approved for use in hazardous locations.

A. Enclosure

Unit shall consist of a tamper-resistant, clear polycarbonate shield and frame that fits over the manual actuation station. The unit shall be hinged on the top and suitably labeled "Lift Here" on the bottom to indicate means of gaining access to the manual actuation station it protects. It shall include a spacer as required to accommodate its use with a surface mounted manual actuation station.

B. Horn

The unit shall include an 85 db at 10 ft integral horn powered by a 9 VDC alkaline battery. Upon lifting of the cover, the horn shall provide a local supervisory alarm. The enclosure shall be suitably labeled "TO ACTIVATE FOAM SYSTEM LIFT COVER AND OPERATE STATION."

2.18 NOTIFICATION APPLIANCES

Notification appliances shall be suitable for connection to supervised alarm indicating circuits. Appliance shall have a separate screw terminal for each conductor.

A. Electronic Signaling Device

Device shall be surface-mounted type which can be mounted to a standard 4 inch square backbox. Device shall be provided with three field-selectable sounds (horn, warble, siren) and three sound output levels to 102 DBA in an anechoic chamber at 10 feet. The device shall be equipped with a 70,000 peak candela (candlepower) strobe light with blue polycarbonate lenses with FIRE lettering which operates independently or in parallel with the audible output. Electronic device shall operate on nominal 24 VDC, shall be polarized for line supervision and shall have screw terminals for in-out wiring.

B. Alarm Horn

Horn shall be surface mounted, with the matching mounting back box surface mounted with matching mounting back box surface mounted single projector grill and vibrating type suitable for use in an electrically supervised circuit. Horns shall operate on nominal 24 VDC and have screw terminals for in-out wiring connection. Sound output shall be a minimum of 85 DBA at 10 feet. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grills.

C. Alarm Bell

Bell shall be surface mounted vibrating type with matching back box. Sound output shall be a minimum of 85 DBA at 10 feet. Unit shall operate on nominal 24 VDC. Unit shall have screw terminals for in-out wiring connection. Bells used in exterior locations shall be specifically listed or approved for outdoor use and shall be provided with metal housing and protective grilles.

PART 3- EXECUTION

3.1 INSTALLATION

A. Aboveground Piping

Piping shall be installed straight and bear evenly on hangers and supports. Piping shall be concealed in areas with suspended ceiling and shall be inspected, tested and approved before being concealed.

1. Joints: Pipe joints shall conform to NFPA 13. Not more than four threads shall show after joint is made up. Teflon tape shall be applied to male threads only. Joints shall be faced true, provided with gaskets and made square and tight. Flanged joints or mechanical groove couplings shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published installation instructions. All grooved couplings and fittings shall be from the same manufacturer.
2. Reducers: Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will

be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

3. Pipe Supports and Hangers: Installation methods outlined in NFPA 13 are mandatory.
4. Pipe Penetrations: Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes penetrating concrete or masonry walls or concrete floors shall be provided with pipe sleeves fitted into place at the time of construction through its respective wall or floor, and shall be cut flush with each surface. Sleeve sizes and clearance between pipe and sleeve shall be in accordance with NFPA 13. Where pipes pass through fire walls, fire partitions, or floors, a fire seal shall be placed between the pipe and sleeve in accordance with Section 07841 - THROUGH PENETRATION FIRE STOP SYSTEMS.
5. Piping Pitch: Piping shall be pitched to the main drain or to auxiliary drains provided as required to facilitate draining. Feedmains shall be pitched to at least 1/4 inch in 10 feet.
6. Escutcheons: Escutcheons shall be provided at finished surfaces where exposed piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe and shall be chromium-plated iron or chromium-plated brass, either one-piece or split-pattern, held in place by internal spring tension or setscrew.
7. Drains: Main drain piping shall be provided to discharge at safe points outside each building. Drains shall be of adequate size to readily receive the full flow from each drain under maximum pressure. Auxiliary drains shall be provided as required by NFPA 13 except that drain valves shall be used where drain plugs are otherwise permitted. Where branch lines terminate at low points and form trapped sections, the branch lines shall be manifolded to a common drain line. Each drain valve shall be provided with a metal sign identifying the type of drain connection or function of the valve.
8. Identification Signs: Signs shall be in accordance with NFPA 13. Properly lettered and approved metal signs shall be suitably affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate.

3.2 ELECTRICAL WORK

Unless otherwise specified, power supply equipment and wiring shall be in accordance with Division 16000. See Section 16721 FIRE DETECTION ALARM AND RADIO TYPE REPORTING SYSTEM. See drawing E1 for locations of control panel and associated devices.

A. Overcurrent and Surge Protection

Equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. Cables and conductors which serve as communication links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

B. Grounding

Grounding shall be provided to building ground.

C. Wiring

System field wiring shall be installed in 3/4 inch minimum diameter electrical metallic tubing or metallic conduit. Wiring for the underwing Hi-X Foam control system shall be installed in tubing or conduits dedicated for that use only and shall not be installed in conduit, outlet boxes or junction boxes which contain lighting and power wiring or equipment. Circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked and labeled in accordance with the wiring diagram. No more than one conductor shall be installed under any screw terminal. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors is not permitted. Wiring within any control equipment shall be readily accessible without removing any component parts. Conductors shall be color coded and shall be identified within each enclosure where a connection or termination is made. Conductor identification shall be by plastic coated, self-sticking, printed markers, or by heat-shrink type sleeves. Circuits shall be wired to maintain electrical supervision so that removal of any single wire from any device shall cause a "trouble" condition on the control panel. See spec section 16721 "Fire Detection, Alarm, and Radio Type Reporting System" for wiring specifications.

D. Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 24 inches nor more than 78 inches above the finished floor.

E. Manual Actuation Stations

Manual actuation stations shall be mounted readily accessible and 42 inches above the finished floor.

F. Notification Appliances

Notification appliances shall be mounted a minimum of 8 feet above the finished floor unless limited by ceiling height.

3.3 PIPE PAINTING AND LABELING

A. Painting

Black steel pipe shall be painted in accordance with the requirements specified under Section 09900 PAINTS AND COATINGS. Pipe in equipment rooms shall be painted red. Pipe in other areas shall be painted to match finishes in those areas. Stainless steel pipe shall not be painted.

B. Pipe Identification

Aboveground pipe 2 inch diameter and larger shall be identified with legends. Legends shall include FOAM CONCENTRATE, HIGH EXPANSION FOAM, and FIRE PROTECTION WATER. Legends shall utilize WHITE letters on a RED color field and shall include arrows to indicate the direction of flow. Length of color field, letter size and locations on piping shall be as recommended in ANSI A13.1.

3.4 PRELIMINARY TESTS

The fire protection system shall be tested to assure that equipment, components and subsystems function as intended. Preliminary tests shall be videotaped to record the methods and equipment employed to conduct the tests. Tests shall be videotaped from start to finish with a video camera which records the date and time lapse (in seconds).

A. Flushing

Underground water mains shall be flushed in accordance with NFPA 13 and NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less than the maximum water demand rate of the system.

B. Hydrostatic Tests

The underground and aboveground piping systems, including HI-X Foam concentrate, shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi, or 50 psi in excess of maximum system operating pressure, for 2 hours. There shall be no visible leakage from the piping when the system is subjected to the hydrostatic test.

C. Alarm Check and Automatic Water Control Valves

Each valve shall be tested to verify operation in accordance with manufacturer's published operating instructions. This shall include tests of valves and switches connected thereto.

D. Generators

Generators shall be discharge tested for proper operation and coverage. generators shall be operated to verify that discharge rate is in accordance with requirements.

E. HI-X Foam Concentrate System

Tests shall be conducted under the supervision of a technician trained and certified by the HI-X Foam concentrate manufacturer. The complete HI-X Foam concentrate system shall be adjusted and tested to assure proper operation. Testing shall include, but not be limited to, the following:

1. Filling the HI-X Foam concentrate tank.
2. Adjustment of proportioners.
3. Collection of HI-X Foam samples and testing with a conductivity meter to verify proportioning accuracy.
4. Other operational checks recommended by the HI-X Foam proportioner manufacturer.

3.5 FINAL TEST

A. Requirements

The Final Test shall be a repeat of Preliminary Tests, except that flushing and hydrostatic tests shall not be repeated. In addition, the system shall be automatically actuated and allowed to discharge for a period of at least one minute prior to shutting the system off. The Contractor shall correct system failures and other deficiencies identified during testing and shall retest portions of the system affected by the required corrections.

1. Pretest Requirements: The system will be considered ready for final testing only after the following have been accomplished.
2. The required test plan has been submitted and approved.
3. Preliminary tests have been made and deficiencies determined to have been corrected to the satisfaction of the equipment manufacturer's technical representatives and the Contracting Officer.
4. Test reports, including the required videotape of the preliminary tests, have been submitted and approved.
5. The control panels and release systems shall have been in service for a break-in period of at least 14 consecutive days prior to the final test.
6. The Contractor has provided written notification to the Contracting Officer, at least 14 days prior to date of Final Test, that preliminary tests have been successfully completed.
7. Videotaping: Contractor shall videotape the tests in VHS format and shall record the date and time-lapse, in seconds, from start to finish of each portion of the test as directed by the Contracting Officer. Four copies of the tape shall be submitted before the system will be considered accepted.
8. Manufacturer's Services: Experienced technicians regularly employed by the Contractor in the installation of the system and manufacturer's representative referred to elsewhere in this specification shall conduct the testing.
9. Materials and Equipment: Contractor shall provide HI-X Foam concentrate, gauges, HI-X Foam sample collection apparatus, instruments, hose, personnel, elevating platforms, scaffolding, ladders,

appliances and any other equipment necessary to fulfill testing requirements specified.

10. Facility and Environmental Protection: Contractor shall provide protection for the facility, including electrical and mechanical equipment exposed to possible damage during discharge tests. This shall include provision of sandbags or similar means for preventing migration of Foam solution into adjacent areas. Temporary measures shall be provided to prevent HI-X Foam solution from entering storm drains, sanitary sewers, drainage ditches, streams and other water sources. Discharged HI-X Foam shall be contained on paved surfaces and shall not be allowed to come in contact with the earth.

B. Control System Tests

Operational features of the control system shall be tested and demonstrated. This shall include testing of control panels and each input and output circuit. Tests of circuits shall include actuation and simulated circuit fault at each initiating, notification, supervisory and actuation device or appliance. As a practical matter, these tests shall be a repeat of preliminary tests required under paragraph PRELIMINARY TESTS.

C. HI-X Foam Proportioning System Tests

Each HI-X Foam proportioner (ratio controller) shall be flow tested to determine that proportioning accuracy is within specified limits. Each proportioner supplying a generator system shall be tested at the design flow rate. Collecting HI-X Foam samples from each proportioner shall be accomplished in accordance with NFPA 16 and the approved test plan. Foam solution concentrations shall be determined using the methods outlined in NFPA 16. Proportioning for nominal 2 3/4 percent concentrate shall be between 3 percent and 4 percent. If test results indicate proportioning below or above this range, the Contractor shall make necessary adjustments and retest as directed by the Contracting Officer.

D. Post-discharge Test Requirements

Following the successful completion of the tests, the Contractor shall remove the Foam solution from the site as indicated on the approved HI-X Foam waste containment and disposal plan. Contractor shall replenish HI-X Foam concentrate consumed during the tests. The entire fire protection system shall be returned to automatic operation and the facility restored to operational capability. Discharged solution shall be contained and disposed of in a manner acceptable to local authorities and as identified on the approved test plan. Once tests are completed, systems shall be returned to fully operational status, including filling of HI-X Foam concentrate tanks with concentrate and filling of solution piping with premix as required.

E. Control System Tests

Tests shall be conducted under the supervision of a factory-trained representative of the control panel manufacturer. The electrical control system shall be tested to verify that the control panel and all wiring have been installed correctly and that all components function as intended. Tests shall be conducted using normal operating and battery power. Testing shall include, but not be limited to, each of the following:

1. Alarm initiating circuit and device, including heat detectors, manual actuation stations, waterflow and pressure switches, and similar devices connected to the control panel.
2. Supervisory circuit and device, including valve supervisory (tamper) switches, pump power circuits, pump running, low liquid level in foam concentrate tank, and similar circuits and devices.
3. Actuation circuit and device, including circuits to automatic water control valves, foam concentrate pumps, fire pumps, and similar circuits related to system activation.
4. Annunciator lamp and notification appliance, including bells, horns, electronic signaling, and similar devices.

3.6 POSTED INSTRUCTIONS

Framed description of system operation, instructions and schematic diagrams of the overall HI-X Foam system and each subsystem, shall be posted where directed. Condensed operating instructions explaining the system for normal operation, refilling the HI-X Foam storage tank, and routine testing shall be included.

3.7 TRAINING

Contractor shall provide at least two training sessions of at least 6 hours each to explain system's operation and maintenance. Training sessions shall be conducted on alternate days to afford flexibility by shift personnel and other attendees. Training sessions shall include classroom instruction and explanation of approved Operation and Maintenance Manuals. Training aids shall be provided as necessary to clearly describe the systems. In addition to classroom instruction, systems shall be operated to provide hands-on demonstrations. Contractor shall include a system actuation using water only, to demonstrate system operation and procedures for resetting the system. Training areas will be provided by the Government in the building where the systems are installed. Dates and times of the training sessions shall be coordinated with the Contracting Officer not less than 15 calendar days prior to the first session.

END OF SECTION 13956

SECTION 15446

SUMP PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes sump pumps for the High Expansion Foam Solution Disposal System.

1.2 SUBMITTALS

- A. Product Data: Include performance curves, furnished specialties, and accessories for each pump indicated.
- B. Shop Drawings: Include layout and connections for pumps, setting drawings with templates, directions for installing foundation and anchor bolts, and other anchorage.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 SUMP PUMPS, GENERAL

- A. Description: Factory-assembled and -tested, single-stage, centrifugal, end-suction sump pump units complying with UL 778. Include motor, operating controls, and construction for permanent installation.
- B. Discharge Pipe End Connections NPS 2-1/2 (DN 65) and Larger: Flanged.
- C. Motors: TEFC, single speed (1750 RPM), with grease-lubricated ball bearings, and non-overloading through full range of pump performance curves. Motors shall be rated for operating in exterior environment.
- D. Finish: Manufacturer's standard paint applied to factory-assembled and -tested units before shipping.

- E. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembling and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

2.2 WET-PIT-MOUNTED, VERTICAL SUMP PUMPS

- A. Description: Vertical, separately coupled, suspended sump pump complying with HI 1.1-1.5 for wet-pit-volute sump pumps. See plan F7 for required pump ratings.

- 1. Manufacturers:

- a. Aurora Pump.
- b. Crane Co.; Deming Div.
- c. Crane Pumps & Systems, Inc.; Weinman Div.
- d. Goulds Pumps, Inc.
- e. Ingersoll-Dresser Pump Co.
- f. PACO Pumps, Inc.
- g. Peerless Pump Co.
- h. Vertiflo Pump Co.
- i. Weil Pump Co.
- j. Or approved equal.

- 2. Pump Arrangement: Duplex.

- 3. Casing: Cast iron, with stainless steel inlet strainer.

- 4. Impeller: ASTM A 48, Class No. 25 A or higher cast iron; statically and dynamically balanced, open or semi-open non-clog design, overhung, single suction, keyed to shaft, and secured by locking cap screw.

- 5. Pump Shaft and Sleeve Bearings: Stainless-steel shaft with bronze sleeve bearings. Include oil-lubricated, intermediate sleeve bearings at 48-inch (1200-mm) maximum intervals if basin depth is greater than 48 inches (1200 mm), and grease-lubricated, ball-type thrust bearings.

- 6. Pump and Motor Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.

- 7. Pump Discharge Piping: Manufacturer's standard galvanized-steel or bronze pipe.

- 8. Basin Cover: Cast iron or steel and suitable for supporting pumps, motors, and controls. Square or rectangular in shape. Cover to cover opening indicated on sheet F7. Refer to "Sump Pump Basins" Article for other requirements.

- 9. Cover Shaft Seal: Stuffing box, with graphite-impregnated braided-yarn rings and bronze packing gland.

- 10. Motor: Mounted vertically on cast-iron pedestal, with thermal overload protection built into pump motors or starters, as appropriate, according to size.

- 11. Control Panel: The manufacture shall furnish a pre-wired electrical control panel which will include the following:

- a. Single enclosure of NEMA 3R galvanized steel with gray baked on enamel paint, fully gasketed door with stainless steel hinges and padlockable door latches.
- b. Two circuit breakers, one for each pump to provide line disconnect and circuit protection.

- c. Two motor starters, horse power rated magnetic, with ambient compensated overload relays;
- d. One control transformer with fused primary and secondary line to 115 volts.
- e. One alternator to alternate lead and lag pumps at the end of each pump cycle and to operate both units if one pump cannot handle load.
- f. Two hand-off-auto selector switches with run lights, one for each pump, the switches and lights will be under the cover of the panel door.
- g. One terminal block for connection of level or pressure controls.
- h. Pedestal-mounted float switches with floats, float rods, and rod buttons.
- i. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell, silencing switch, and 40 watt light; 120-V ac, with transformer and contacts for remote alarm bell, unless battery operation is indicated.
- j. Mounting stand.

2.3 SUMP PUMP BASINS

- A. Description: Field fabricated with sump, pipe connections, and separate cover.
 - 1. Basin Sump: Fabricate watertight, with sidewall openings for pipe connections.
 - a. Material: Concrete.
 - b. Reinforcement: Mounting plates for pumps, fittings, and accessories.
 - c. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
 - 2. Basin Cover: Fabricate with openings with gaskets, seals, and bushings, for access, pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 - a. Material: Steel plate.
 - b. Reinforcement: Steel or cast-iron reinforcement capable of supporting foot traffic for basins installed in foot-traffic areas.
 - 3. Pump Enclosure: Provide manufactured pump motor and control panel enclosure for sump pump assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pumps and arrange to provide access for maintenance, including removal of motors, impellers, couplings, and accessories.
- B. Support piping so pumps do not support weight of piping.
- C. Wet-Pit-Mounted, Vertical Sump Pumps: Suspend pumps from basin covers. Make direct connections to storm drainage piping.

- D. Sump Pump Basins: Construct basins and connect to diverted storm drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top. Install so top surface of cover is flush with finished floor.

3.2 CONNECTION

- A. Storm drainage piping installation requirements are specified in Section 02630 "Storm Drainage." Drawings indicate general arrangement of piping and specialties.
 - 1. Install discharge pipes sizes equal to or greater than diameter of pump nozzles, and connect to storm drainage piping discharging to retention pond.
 - 2. Install swing check valve and gate or ball valve on each sump pump discharge. Include spring-loaded or weighted-lever check valves for piping NPS 2-1/2 (DN 65) and larger.
- B. Install electrical connections for power, controls, and devices. Electrical power and control components, wiring, and connections are specified in Division 16 Sections.
- C. Ground equipment.
- D. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.

3.3 SEQUENCE OF OPERATION

- A. The pump motors are controlled by hand-off-auto selector switches located under cover of the panel door. In "hand" position these selectors will start their respective pump which will run continuously until the switch is placed in the "off" position. Turning both selector switches in the "auto" position will arm the level controls and cause the pumps to automatically start and stop with the rise and fall of the water level in the sump.
- B. With the sump level rising the stop float will close. When the water reaches the level of the start float, the lead pump will start and pump the pit down to the level of the stop float, which opens and stops the lead pump. This de-energizes the alternator and will transfer and select the lag pump as the lead on the next pumping cycle.
- C. If the water level continues to rise with the lead pump running the lag start float will start the lag pump. The two pumps will run together until the level drops below the stop float. Both pumps will stop. The alternator will then select the lag pump for lead on the next cycle.
- D. If the water level continues to rise with lead and lag pump running, the high water alarm float will activate the alarm. The audible alarm will sound and alarm light will flash. The audible alarm can be silenced with the alarm "off" switch that is under the cover of the panel door, but the alarm light will keep flashing until the water level has been pumped below the alarm float level. At this point the alarm silence relay will reset readying the alarm for use.

END OF SECTION 15446

SECTION 16060

GROUNDING AND BONDING

1 - GENERAL

1.1 SUMMARY

- A. Extent of electrical grounding and bonding work is indicated by the Drawings and Schedules and as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.
- B. Type of electrical grounding and bonding work specified in this section includes the following:
 - 1. Solidly grounded.
- C. Applications of electrical grounding and bonding work in this section includes the following:
 - 1. Electrical power systems.
 - 2. Ground bars.
 - 3. Raceways.
 - 4. Enclosures.
 - 5. Equipment.
- D. Refer to other Division 16 sections for wires/cables, electrical raceways, boxes and fittings, and wiring devices which are required in conjunction with electrical grounding and bonding work.

1.2 QUALITY ASSURANCE

- A. **Manufacturer's Qualifications:** Install grounding and bonding products of firms regularly engaged in the manufacture of these materials, including stranded cable, grounding rods, and bonding jumpers.
- B. **Electrical Code Compliance:** Comply with the applicable State electrical code requirements of the authority having jurisdiction, and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.
- C. **UL Compliance:** Comply with applicable requirements of UL Standards No.'s 467, "Electrical Grounding and Bonding Equipment," and 869, "Electrical Service Equipment," pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Standard 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are UL listed and/or labeled for their intended usage.

1.3 SUBMITTALS

- A. Product Data: For each type of product specified.

2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering grounding products which may be incorporated in the work include, but are not limited to, the following (or approved equal):

1. B-Line Systems, Inc.
2. Burndy Corporation.
3. Gould Inc.
4. Ideal Industries, Inc.
5. Thomas & Betts Corp.

2.2 MATERIALS AND PRODUCTS

- A. General: Except as otherwise indicated, provide electrical grounding and bonding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, ground bars, bonding jumpers, and additional accessories needed for a complete installation.
 1. Where more than one type component product meets indicated requirements, selection is Contractor's option.
 2. Where materials or components are not indicated, provide products which comply with NEC and UL requirements and with established industry standards for those applications indicated.
- B. Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding system connections that match power supply wiring materials and are sized according to NEC.
- C. Bonding Connectors, Terminals and Clamps: Provide electrical bonding connectors, terminals, lugs and clamps as recommended by bonding connector, terminal and clamp manufacturers for indicated applications.
- D. Ground Bars: 1-1/2" wide x 1/4" thick copper ground bar.
- E. Electrical Grounding Connection Accessories: Provide electrical insulating tape, bonding straps, as recommended by accessories manufacturers for type service indicated.

3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which electrical grounding and bonding connections are to be made and notify the Contracting Officer or authorized representative in writing of conditions detrimental to proper completion of work.
- B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS

- A. General: Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions and applicable portions of NEC, OSHA, and NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements.
- B. Provide a separate, insulated equipment grounding conductor from each device to ground buses in panelboards. Terminate each end on a grounding lug, bus, or insulated grounding bushing.
- C. Provide grounding system per the Drawings and Article 250 of the NEC. Provide green equipment grounding conductor for all electrical raceways.
- D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.
- E. Provide clamp-on connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester.
 - 1. Where tests show resistance-to-ground is over 25 ohms, take appropriate action to reduce resistance to 25 ohms, or less, by driving additional ground rods.
 - 2. Retest grounding system to demonstrate compliance.
- B. Provide written certified testing report indicating resistance-to-ground value.

END OF SECTION 16060

SECTION 16120

CONDUCTORS AND CABLES

1 - GENERAL

1.1 SUMMARY

- A. Extent of electrical wire and cable work is indicated by the Drawings and Schedules for low voltage wire and cable - 600V and below.
- B. Types of electrical wire, cable, and connectors specified in this section include but are not limited to the following:
 - 1. Copper conductors.
 - 2. Fixture wires.
 - 3. Split-bolt connectors.
 - 4. Wirenut connectors.
- C. Applications of electrical wire, cable, and connectors required for this Project include but are not limited to the following:
 - 1. For power distribution circuits.
 - 2. For building lighting circuits.
 - 3. For appliance and equipment circuits.
 - 4. For motor-branch circuits.

1.2 SUBMITTALS

- A. Product Data: For each type of product specified.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required.
- B. NEC Compliance: Comply with NEC requirements as applicable to construction, installation and color coding of electrical wires and cables.
- C. UL Compliance: Provide wiring/cabling and connector products which are UL listed and/or labeled.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type wire and cable reels.
- B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

- C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of wire, cable, and connector) (or approved equal):

- B. Wire and Cable:

1. American Insulated Wire Corp.
2. Cabelec Corp.
3. General Cable Corp.
4. Okonite Company.
5. Rome Cable Corp.
6. Southwire Company.
7. Triangle PWC, Inc.

- C. Connectors:

1. AMP, Inc.
2. Appleton Electric Co.; Emerson Electric Co.
3. Electrical Products Div.; Midland-Ross Corp.
4. Ideal Industries, Inc.
5. 3M Company
6. O-Z/Gedney Co.
7. Square D Company.
8. Thomas & Betts Corp.

2.2 SECONDARY VOLTAGE WIRES, CABLES, AND CONNECTORS

- A. General: Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated. Provide copper conductors with conductivity of not less than 98% at 68 degrees F.

- B. Building Wires: Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Contractor to comply with project's installation requirements, NEC and NEMA standards. Select from the following UL types, those wires with construction features which fulfill project requirements:

1. Type THWN: For dry and wet locations; maximum operating temperature 75 degrees C (167 degrees F). Insulation, flame-retardant, moisture- and

- heat-resistant, thermoplastic; outer covering, nylon jacket; conductor, annealed copper.
2. Type THHN (Interior Branch Circuits): For dry and damp locations; maximum operating temperature 90 degrees C (194 degrees F). Insulation, flame-retardant, heat-resistant, thermoplastic; outer covering, nylon jacket; conductor, annealed copper.
- C. Cables: Provide UL type factory-fabricated cables of sizes, ampacity ratings, and materials and jacketing/sheathing as indicated for services indicated. Where not indicated, provide proper selection as determined by Contractor to comply with installation requirements, NEC and NEMA standards.
- D. Conductors No. 10 and smaller may be solid or stranded and conductors larger than No. 10 shall be stranded. Control wire shall be stranded copper.
- E. Connectors:
1. General: Provide UL type factory-fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated.
 2. Where not indicated, provide proper selection as determined by the Installer to comply with the project's installation requirements, and with NEC and NEMA standards.
 3. Select from the following, those types, classes, kinds and styles of connectors to fulfill project requirements:
 - a. Type: Pressure, threaded.
 - b. Class: Insulated.
 - c. Kind: Copper (for Cu to Cu connection).
 - d. Style: Tap, pigtail, wirenut, split bolt, T-connections.

3 - EXECUTION

3.1 TESTING

3.1 INSTALLATION OF WIRES AND CABLES

- A. General: Install wires and wiring connectors as indicated, in compliance with applicable requirements of NEC, NEMA, OSHA, UL, and NECA's "Standard of Installation," and in accordance with recognized industry practices.
- B. Coordinate wire/cable installation work including electrical raceway and equipment installation work, as necessary to properly interface installation of wires/cables with other work.
- C. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring (fire alarm).
- D. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 120 feet, unless otherwise noted on the Drawings.

- E. Place an equal number of conductors for each phase of a circuit in same raceway, unless indicated otherwise on the Drawings.
- F. Neatly train and lace wiring inside boxes, equipment and panelboards.
- G. Make conductor lengths for parallel circuits equal.
- H. Conductors shall be color coded; (1) ground leads, green; (2) grounded neutral leads, white (120 volts); (3) ungrounded phase wires, black, red, and blue (208Y/120V); (4) ungrounded phase wires, brown, orange, and yellow (480Y/277V); (5) switch leg travellers, purple.
- I. Install exposed cables parallel and perpendicular to surfaces, or exposed structural members, and follow surface contours, where possible.
- J. Completely and thoroughly swab raceway system before installing conductors.
- K. Branch circuit wiring shall not loop through receptacle terminals, but shall be connected by means of conductor taps joined to branch circuit conductors. At end of run, branch circuit conductors may terminate on receptacle terminals.
- L. Position all splices in pull boxes and junction boxes of adequate volume so they are accessible from the removable cover side of the box.
- M. Conductors for signal systems shall be continuous and shall be terminated on terminal strips or terminate in a manner approved by the system's manufacturer.
- N. All neutrals and ground wires in panels shall be labeled with numbered tape to indicate the circuits being served.
- O. Pull conductors simultaneously where more than one is being installed in same raceway.
- P. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.
- Q. Use pulling means including fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway.
- R. Keep conductor splices to minimum.
- S. Install splices and taps which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- T. Use splice and tap connectors which are compatible with conductor material.
- U. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where

manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A and B.

- V. Conductors manufactured more than twelve months prior to date of delivery to site shall not be used.

3.2 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible junction boxes.
- B. Splices, taps and attachments of fittings and lugs shall be electrically and mechanically secure. Connectors and lugs shall be correct size for conductors joined.
- C. Solid conductors, namely those sized No. 10 AWG copper, and smaller, shall be spliced by using Ideal "Wing-Nuts," 3M Co.'s "Scotchlox" or T&B "Piggy" conductors (or approved equal) in junction boxes and light fixtures, except recessed fixtures as noted below.
 - 1. "Sta-Kon" or other permanent type crimp connectors shall not be used.
 - 2. Contractor shall use Ideal "Wing-Nuts" for splicing recessed lighting fixture leads to branch circuit conductors.
- D. Stranded conductors, namely No. 8 AWG and larger, shall be spliced by UL listed mechanical connectors plus gum tape, plus friction or plastic tape. Solderless mechanical connectors, for splices and tape provided with UL listed insulating covers, may be used instead of mechanical connectors plus tape.
- E. Conductors, in all cases, shall be continuous from outlet to outlet, and no splicing shall be made except within outlet or junction boxes, troughs, and gutters.
- F. Lugs for conductors No. 6 through No. 1/0 AWG shall be copper, split bolt type with spacer. Lugs for connectors No. 2/0 AWG and larger shall be copper 2-bolt type with spacer. Lugs shall be as manufactured by AMP, Inc. (or approved equal).
- G. Taping of joints shall be made using special oil resistant vinyl plastic tape; UL listed, rated 105 degrees C, Scotch Electrical Tape No. 33+ or reviewed equal.
- H. Splices in grounding conductors No. 8 AWG and larger shall be by means of exothermic welding and termination shall be by means of approved grounding connectors. Soldering shall not be used.
- I. Thoroughly clean wires before installing lugs and connectors.
- J. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- K. Terminate spare conductors with electrical tape.

3.3 FIELD QUALITY CONTROL

- A. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

3.4 WIRE AND CABLE INSTALLATION SCHEDULE

- A. Exposed Interior Locations: Building wire in raceway.
- B. Above Accessible Ceilings: Building wire in raceway.
- C. Exterior Locations: Building wire in raceway.

END OF SECTION 16120

SECTION 16130

RACEWAYS AND BOXES

1 GENERAL

1.1 SUMMARY

- A. Extent of raceway work is indicated by the Drawings and Schedules.
- B. Types of raceways specified in this section include the following:
 - 1. Electrical metallic tubing (EMT).
 - 2. Flexible metal conduit.
 - 3. Liquid-tight flexible metal conduit.
 - 4. Rigid steel conduit (RSC).
 - 5. Rigid nonmetallic conduit.
 - 6. Surface metal raceways.
- C. This section specifies the following raceways:
 - 1. Raceways installed within buildings.
- D. Types of electrical boxes and fittings specified in this section include the following.
 - 1. Outlet boxes.
 - 2. Junction boxes.
 - 3. Pull boxes.
 - 4. Bushings.
 - 5. Locknuts.
 - 6. Knockout closures.

1.2 SUBMITTALS

- A. Product data for each type of product specified.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required.
- B. Manufacturers: Firms regularly engaged in manufacture of electrical boxes and fittings of types and sizes required.

1.4 CODES AND STANDARDS:

- A. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publications pertaining to raceways.

- B. UL Compliance and Labeling: Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems. Provide raceway products and components which have been UL listed and/or labeled.
 - 1. UL No. 1: Flexible Metal Conduit
 - 2. UL No. 6: Rigid Steel Conduit, Zinc Coated
 - 3. UL No. 6: Rigid Steel Conduit, Enameled
 - 4. UL No. 651: Schedule 40 and 80 Rigid PVC
 - 5. UL No. 797: Electrical Metallic Tubing, Zinc Coated
- C. NEC Compliance: Comply with applicable requirements of the latest edition of the NEC pertaining to construction and installation of raceway systems.
- D. ANSI Publications:
 - 1. C80.1 Rigid Steel Conduit, Zinc Coated
 - 2. C80.2 Rigid Steel Conduit, Enameled
 - 3. C80.3 Electrical Metallic Tubing, Zinc Coated
- E. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL listed and/or labeled.
- F. NEMA Compliance: Comply with applicable requirements of NEMA Stds/Pub No's OS1, OS2, and Pub 250 pertaining to outlet and device boxes, covers and box supports.

2 PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements, and comply with applicable portions of NEC for raceways.
- B. Rigid Steel Conduit (RSC): Low carbon malleable iron, cadmium plated or hot-dipped galvanized inside and outside, with threaded ends, minimum size $\frac{3}{4}$ inch. Threaded Fittings - alloy steel, galvanized.
- C. Electrical Metallic Tubing (EMT): High strength galvanized, minimum size $\frac{3}{4}$ inch, maximum size two (2") inch. Fittings shall be made of same finish and material as tubing. Use compression type fittings only.
- D. Flexible Metal Conduit: Formed with continuous length of spirally wound, interlocked zinc-coated strip steel, minimum size $\frac{1}{2}$ inch, for connections to recessed lighting fixture only.
 - 1. Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type.

2. Straight Terminal Connectors: One piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
 3. 45 degrees or 90 degrees Terminal Angle Connectors: Two-piece body construction with removable upper section female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
- E. Liquidtight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit; construct of single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC), 3/4-inch minimum size.
1. Manufacturers:
 - a. Sealtite Type "UA" Anaconda, Liguatite Type "LA"
 - b. Electri-Flex Co., International Metal Hose Co.
 - c. Universal Metal Hose Company "Sealflex-U".
 2. Fittings shall be Series "6000" as manufactured by:
 - a. Thomas & Betts
 - b. Crouse-Hinds
 - c. Electri-Flex.
 3. Where an external ground is required, fittings shall be Series "5200GR" or "5300GR."
 4. Special care shall be taken to be sure that conduit bending radius limitations are not exceeded.
- F. Expansion/Deflection Fittings: Watertight Type "XC" or Type "DX" with integral bonding jumper for rigid metal conduit permitting movement up to 3/4 inch in any direction and angular deflection up to 30 degrees from normal in all directions as manufactured by:
1. Crouse-Hinds.
 2. O-Z/Gedney.
 3. Appleton.
- G. Sealing Fittings or Bushings: Series "EYS", "EZD" or "EZX" (as applicable) as manufactured by:
1. Crouse-Hinds.
 2. Pyle National.
 3. Appleton.
- H. Thruwall Sealing Fittings: Type "WKS" as manufactured by:
1. O-Z/Gedney.
 2. Appleton.
 3. Crouse-Hinds.
- I. Fire-Seal Fittings: Type "CFSI" as manufactured by:

1. O-Z/Gedney.
2. Appleton.
3. Crouse-Hinds.

J. EMT Conduit Couplings:

1. Compression: Type "5120" (raintight) as manufactured by:
 - a. Thomas & Betts.
 - b. Raco.
 - c. O-Z/Gedney.
2. Couplings shall be of steel construction.
3. Screw type couplings are not premitted.

K. EMT Conduit Connectors:

1. Compression: Type "5123" (raintight, insulated throat) as manufactured by:
 - a. Thomas & Betts.
 - b. Raco.
 - c. O-Z/Gedney.
2. Connectors shall be of steel construction.
3. Screw type connectors are not premitted.

L. Conduit Bushings:

1. Insulated: Type "B" or "SBT" (as applicable) as manufactured by:
 - a. O-Z/Gedney.
 - b. Steel City.
 - c. Myers.
2. Grounding: Type "BLG" as manufactured by:
 - a. O-Z/Gedney.
 - b. Thomas & Betts.
 - c. Myers.

M. Conduit Locknuts:

1. Case-hardened locknuts shall be equal to Series No. 140 by:
 - a. Thomas & Betts.
 - b. Midwest Electric.
 - c. O-Z/Gedney.

2.2 MISCELLANEOUS MATERIAL AND FITTINGS

A. Pulling in Wire: Provide 5/32 inch polyethylene rope.

B. Thread lubricant/sealant shall be Type "STL" as manufactured by:

1. Crouse-Hinds.
2. Greenlee Tool.
3. Ideal Industries.

- C. When required on joints for heat producing elements (such as lighting fixtures), thread lubricant shall be Type "HTL" as manufactured by:
 - 1. Crouse-Hinds.
 - 2. Ideal Industries.
 - 3. 3M Company.

- D. Nest Back Spacers: Type "NG" by:
 - 1. O-Z/Gedney.
 - 2. Appleton.
 - 3. Raco.

- E. Conduit Bodies:
 - 1. Provide galvanized cast-metal conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements.
 - 2. Construct conduit bodies with threaded-conduit-entrance ends, removable covers, either cast or of galvanized steel, and corrosion-resistant screws.
 - 3. Manufacturers: Subject to compliance with requirements, provide conduit bodies of one of the following:
 - a. Appleton Electric; Div. of Emerson Electric Co.
 - b. Crouse-Hinds Co.
 - c. Killark Electric Mfg. Co.

2.3 NONMETALLIC CONDUIT

- A. General: Provide nonmetallic conduit and fittings of types, sizes and weights for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements which comply with provisions of NEC for raceways.

- B. Electrical Plastic Conduit (PVC):
 - 1. Extra Heavy Wall Conduit: Schedule 80, 90degreesC, constructed of polyvinyl chloride and conforming to NEMA TC-2, for direct burial, or concrete-encased use, UL listed and in conformity with NEC Article 347.
 - 2. All vertical ells shall be heavy wall rigid steel conduit.

- C. PVC Conduit Fittings: NEMA TC 3, mate and match to conduit or tubing type and material.

- D. Conduit, and Tubing Accessories: Provide conduit, tubing and duct accessories of types, sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.

2.4 WIREWAYS

- A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps, and other components and accessories as required for a complete system.
1. Indoors, wireway shall be NEMA 1.
 2. The wireways shall include all necessary accessories and fittings to make a complete installation.
 3. NEMA 1 wireway shall be Bulletin F-40 as manufactured by Hoffman, Square D or Parker Electrical.
 4. Outside wireways shall be NEMA 3R.
- B. Lay-in Wireways: Construct lay-in wireways with hinged covers, in accordance with UL 870.
1. Select units to allow fastening hinged cover closed without use of parts other than standard lengths, fittings and connectors. Provide captive type screws.
 2. Construct units to be capable of sealing cover in closed position with sealing ears.
 3. Provide wireways with knockouts.
 4. Covers may require field splicing to be installed in accordance with N.E.C..
- C. Connectors: Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached so that removal is not necessary to utilize the lay-in feature.
- D. Finish: Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.

2.5 ELECTRICAL SURFACE METAL RACEWAYS

- A. Two-piece type with single compartment, length as indicated. Provide nominal 4-3/4" x 3-9/16" with flush, snap-on cover. Factory gray enamel finish. Provide couplings, elbows, connectors, circuit breakers (rated 20AIP to protect receptacles indicated on the Drawings), wiring, receptacles (rated as noted on the Drawings). Provide insulated equipment ground conductor. Wire and mount receptacles on 18" centers. Install devices as indicated in raceway on the Drawings. Raceway shall be Wiremold G-6000.
1. Color shall be manufacturer's standard finish color unless noted otherwise.
 2. All electrical surface metal raceways and components shall be painted two (2) coats to match existing surface on which it is mounted.

3. Include all fittings, elbows, connectors, covers, grounding devices, boxes, and extensions.
- B. Boxes for Surface Raceways: Designed, manufactured and supplied by raceway manufacturer for use with specified raceway.
- C. Manufacturers: Subject to compliance with requirements, provide surface metal raceways of one of the following:
1. Power-Strut Div., Youngstown Sheet and Tube Co.
 2. Square D Company
 3. Wiremold Company

2.6 BOXES AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
- B. Interior Outlet Boxes (or approved equal):
1. Appleton Electric
 2. Emerson Electric Co.
 3. General Signal Co.
 4. Harvey Hubbell Inc.
 5. Midland-Ross Corp.
 6. O-Z/Gedney
 7. RACO Div.
 8. Thomas & Betts Co.
- C. Raintight Outlet Boxes (or approved equal):
1. Appleton Electric
 2. Arrow-Hart Div.
 3. Crouse-Hinds Co.
 4. Emerson Electric Co.
 5. General Signal Co.
 6. Harvey Hubbell, Inc.
 7. O-Z/Gedney
- D. Junction and Pull Boxes (or approved equal):
1. Appleton Electric
 2. Arrow-Hart Div.
 3. Emerson Electric Co.
 4. General Signal Co.
 5. O-Z/Gedney Co.
 6. Spring City Electrical Mfg. Co.
- E. Bushings, Lockout Closures and Locknuts (or approved equal):

1. AMP, Inc.
2. General Signal Co.
3. Harvey Hubbell Inc.
4. Midland-Ross Corp.
5. O-Z/Gedney Co.
6. RACO Div.
7. Thomas & Betts Co., Inc.

2.7 FABRICATED MATERIALS

- A. Outlet Boxes: Provide galvanized coated flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations.
 1. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides.
 2. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment grounding.
- B. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Contractor's code-compliance option.
- C. Device Boxes: Provide galvanized coated flat rolled sheet-steel non-gangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations.
 1. Construct device boxes for flush mounting with mounting holes, and with cable-size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices.
 2. Provide cable clamps and corrosion-resistant screws for fastening cable clamps, and for equipment type grounding.
 3. Where multi-device boxes are required, provide gangable boxes where more than one device is mounted together.
- D. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Contractor's code-compliance option.
- E. Raintight Outlet Boxes: Provide NEMA 3R corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring-hinged watertight caps suitable configured for each

application, including face plate gaskets and corrosion-resistant plugs and fasteners.

- F. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, no knockouts, UL listed, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.
 - 1. Boxes larger than 12" in any dimension shall be provided with hinged cover.
 - 2. Provide steel barriers in boxes with feeder circuits of different voltages.
- G. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit insulated bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

3 EXECUTION

3.1 GENERAL

- A. All installation shall comply with the NEC and OSHA.

3.2 EXAMINATION

- A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways.
- B. Notify Contracting officer's representative in writing of conditions detrimental to proper completion of the work.
- C. Do not proceed with work until unsatisfactory conditions have been corrected.

3.3 INSTALLATION OF CONDUITS

- A. Install conduit concealed unless indicated otherwise on the Drawings. Maintain minimum distance of six (6") inches from parallel runs of flues, steam or hot water pipes.
- B. Use liquid-tight flexible metal conduit for connections to motors, transformers and other equipment subject to vibration and in areas subject to moisture.
- C. Use flexible metal conduit for connections to recessed and/or semi-recessed lighting fixtures.
- D. Space groups of conduits uniformly. For bends and offsets, use an approved hickey or bending machine.
- E. Cut all conduit with hacksaw or approved cutting machine and ream after threading to remove all burrs.

- F. Fasten conduit securely to outlets, junctions and pullboxes to ensure firm electrical contact.
 - 1. Join conduit with approved couplings.
 - 2. No running threads will be allowed.
 - 3. Install insulated bushings and double locknuts on threaded conduits entering or leaving sheet metal outlet, junction, or pull boxes, and cabinets.
 - 4. Install grounding bushings on all conduits entering an enclosure such as a motor control center from below where the conduit is not attached to the enclosure.
 - 5. Bond all bushings to ground bus using conductor the same size as the equipment grounding conductor in the conduit.
 - 6. Install compression type connectors with insulated throats on electrical metallic tubing entering or leaving sheet metal outlet, junction or pull boxes and cabinets.

- G. Avoid condensation pockets in installations. Keep conduit, fittings, and boxes free from foreign matter, before, during and after installation.

- H. Do not use EMT in wet areas, in floor slabs, within outside walls below grade, below grade, or exposed except on ceilings and in vertical runs no less than four (4') feet above floor.

- I. Use electrical surface metal raceway for extensions of circuits only where specifically indicated on the Drawings.

- J. Not more than one (1) exposed conduit shall be run down to an exposed wall switch or outlet box.

- K. Use expansion/deflection fittings where rigid metal conduits pass from existing building structures to additions on new foundations, every 200 feet linear run maximum, and where otherwise indicated on the Drawings.

- L. Use thruwall sealing fittings where conduits enter buildings or vaults below finished grade.

- M. Conduits less than one (1") inch may be installed in concrete but shall not cross each other. Installation of larger conduits in concrete must be approved by Engineer.

- N. Do not use aluminum conduit on this project.

- O. Support runs of metallic conduit at least every eight (8') feet.

- P. Support runs of non-metallic conduit at least as required by NEC Table 352.30.

- Q. Install runs of conduit parallel or perpendicular to walls, structural members or intersections of vertical planes and ceilings. Provide right angle turns consisting of fittings or symmetrical bends.
- R. Support conduits within one (1') foot of all changes in direction. Supports shall include wall brackets, trapeze hangers, strap hangers or pipe straps secured to hollow masonry with toggle bolts, to brick and concrete with expansion bolts, to metal surfaces with machine screws and to wood with wood screws.
- S. The use of wooden plugs (inserted in masonry), tie wire or nails as fastening media is prohibited.
- T. Conduit shall not be supported from metal roof deck.
- U. Provide pitchpocket where conduit penetrates roof.
- V. Conduit shall not penetrate concrete bases designed for vibration isolation.
- W. Apply thread lubricant/sealant to joints of all conduit buried in earth or concrete encased.
- X. Use PVC conduit only where specifically indicated on the Drawings.
 - 1. Schedule 80 PVC shall be used in floor slabs within the building limits, in underground site distribution and shall be concrete encased where detailed on the Drawings.
- Y. Install fire-seal fittings or UL classified foam sealant where conduits penetrate concrete floor slabs or masonry walls required to be fire rated.
- Z. Use nest back spacers in conjunction with conduit spacers or clamp backs when additional spacing away from mounting surface is required.
- AA. All conduits shall be installed as high as possible in the ceiling cavity. Coordinate all conduit installation with ductwork.
- BB. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.
- CC. Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split coupling, and plugs that have been specifically designed and manufactured for their particular application.
- DD. Use roughing-in dimensions of electrically operated unit furnished by supplier.
- EE. Set conduit and boxes for connection to units only after receiving review of dimensions and after checking location with other trades.
- FF. Provide nylon pull string in empty conduits where indicated.

- GG. Test conduits required to be installed, but left empty, with ball mandrel.
- HH. Clear any conduit which rejects ball mandrel.
- II. Pay costs involved for restoration of conduit and surrounding surfaces to original condition.
- JJ. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.
- KK. Field-bend conduit with benders designed for purpose so as not to distort or vary internal diameter.
- LL. Size conduits to meet NEC, except no conduit smaller than $\frac{3}{4}$ inch shall be installed.
- MM. Fasten conduit terminations in sheet metal enclosures by 2 locknuts, and terminate with insulated bushing. Install locknuts inside and outside of enclosure.
- NN. Conduits are not to cross pipe shafts or ventilating duct openings.
- OO. Support riser conduit at each floor level with clamp hangers.
- PP. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.
- QQ. Complete installation of electrical raceways before starting installation of cables/wires within raceways.
- RR. Support exposed conduit by use of hangers, clamps or clips.
1. Support conduit within 3'-0" of each outlet box, junction box, cabinet or fitting and on each side of bends and on spacing not to exceed following:
Rigid metal conduits up to 1": 6'-0"; 1-1/4" and over: 8'-0"; EMT up to 1": 5'-0"; 1-1/4" and over: 8'-0".
 2. Arrange conduit supports to prevent distortion of alignment by wire pulling operations.
 3. Fasten conduit using galvanized straps, caddy clamps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
 4. Requirements for exposed conduits also apply to conduits installed in space above hung ceilings.
- SS. Exposed Conduits:
1. Install conduits as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls.
 2. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.

3. Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets.
4. Run conduits for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.
5. Requirements for exposed conduit also apply to conduits installed in space above hung ceilings.

- TT. Non-Metallic Conduit:
1. Make solvent cemented joints in accordance with recommendations of manufacturer.
 2. Install PVC conduits in accordance with NEC.
- UU. Conduit Fittings:
1. Construct locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.
 2. Install insulated throat connectors for terminating EMT.
 3. Install insulated type bushings for terminating conduits. Bushings are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.
 4. Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split coupling, and plugs to be specifically designed for their particular application.
- VV. Install expansion fittings in all raceways wherever structural expansion joints are crossed.
- WW. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer.
- XX. Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported.
- YY. Use boxes as supplied by raceway manufacturer wherever junction, pull or devices boxes are required. Standard electrical "handy" boxes, etc. shall not be permitted for use with surface raceway installations.
- ZZ. Arrange conduit to maintain headroom and present a neat appearance.
- AAA. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- BBB. Group conduits in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25% additional conduit.
- CCC. Do not fasten and/or hang conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.
- DDD. Bring conduit to the shoulder of fittings and couplings and fasten securely. Raceways shall be cut to proper length so ends fit accurately in outlets.
- EEE. Use conduit hubs for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.

- FFF. Install no more than the equivalent of three (3) 90 degree bends between boxes.
- GGG. Use conduit bodies to make sharp changes in direction, as around beams.
- HHH. Use hydraulic one-shot conduit bender for bends in conduit smaller than 2" size, or factory elbows for bends in conduit 2" and larger. Bends in metallic conduit shall be made while "cold."
- III. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- JJJ. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- KKK. EMT shall not be permitted in exterior walls or underground.
- LLL. Where conduit penetrates fire rated walls, provide pipe sleeve two sizes larger than conduit; seal opening around conduit with UL listed foamed silicone elastomer compound.
- MMM. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket.
- NNN. Combining of circuits other than as indicated on the Drawings shall not be permitted.
- OOO. Bolts, clamps, screws and expansion bolts shall be used in securing conduit, equipment, etc. Holes for lead shields shall be drilled in solid brick or concrete and must be neatly cemented after bolts are in place.

3.4 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

- A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, OSHA, and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.
- D. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

- F. Avoid installing boxes back-to-back in walls. Where receptacles are shown back-to-back in walls, they shall be mounted in separate boxes, a minimum of 6" apart (24" in acoustic rated walls) and connected together using flex with ground wire. Flex will not be acceptable for system grounding. The flex shall have a loop for limiting sound transmissions. Outlet boxes shall be equipped with plaster rings of appropriate depth to finish flush with finished wall. Outlets in exposed masonry walls shall be equipped with extra deep square corner tile rings so that boxes may be installed in brick walls or in the core of the block.
- G. Aluminum products shall not be installed.
- H. Position recessed outlet boxes accurately to allow for surface finish thickness.
- I. Do not use round boxes unless noted otherwise on the Drawings.
- J. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Boxes shall be supported independently of conduit.
- K. Provide electrical connections for installed boxes.
- L. Electrical box locations indicated on the Drawings are approximate unless dimensioned. Verify location of outlets prior to rough-in. Outlet may be relocated by the Contracting Officer or authorized representative at no additional cost.
- M. Locate and install to maintain headroom and to present a neat appearance.
- N. Use multiple gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- O. Install boxes in walls without damaging wall insulation.
- P. Position outlets to locate luminaries as indicated on the Drawings.
- Q. Align wall mounted outlet boxes for switches, thermostats, and similar devices.
- R. Subsequent to installation of boxes, protect boxes from construction debris and damage.
- S. Support all outlet boxes as required by the NEC. Suspended outlet boxes shall be independently supported from raceway by means of 1/4" all thread rod to structure.
- T. All outlet boxes or plaster rings shall finish flush with finished wall or ceiling. Outlets which do not finish flush (recessed) shall be equipped with copper tube stand-off nipples of proper length to hold wiring device securely in place. Wiring device shall be secure and shall not push in or rock.

3.5 GROUNDING

- A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements of Section 16060 – GROUNDING AND BONDING.

3.6 JUNCTION AND OUTLET BOX IDENTIFICATION:

- A. Identify each junction and outlet box cover with color and the type system that is within the box. Sample identifications are as follows:
- B. Fire Alarm (Red): Name "FIRE ALARM".
- C. The written labels above shall be neatly and legibly marked on the outside of the box covers using a permanent black ink marker.

END OF SECTION 16130

SECTION 16140

WIRING DEVICES

1 - GENERAL

1.1 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.

1.2 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

1.3 SUBMITTALS

- A. Product Data: For each product specified.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

1.5 COORDINATION

- A. Receptacles for Government-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Wiring Devices (or approved equal):
 - a. Bryant Electric, Inc.
 - b. Eagle Electric Manufacturing Co., Inc.
 - c. GE Company; GE Wiring Devices.
 - d. Hubbell, Inc.; Wiring Devices Div.
 - e. Killark Electric Manufacturing Co.
 - f. Leviton Manufacturing Co., Inc.

- g. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 RECEPTACLES

- A. Provide NEMA configuration 5-20R duplex 125 Volt grounding type receptacles rated for 20 Amperes unless otherwise indicated on the Drawings.
- B. Receptacles shall be specification grade, Bryant "5362" series, Hubbell "5352" series, P&S "5362" series, G.E., "5362" series, Sylvania "5362" series or Slater "5362" series (or approved equal).
- C. Receptacle color shall be ivory in finished areas and brown in unfinished areas.

2.3 OTHER RECEPTACLES

- A. Receptacles requiring a current or voltage rating or configuration different from duplex convenience receptacles shall be as indicated on the Drawings.
- B. Provide other receptacles with quality, material and workmanship at least equal to that specified for duplex convenience receptacles.
- C. Ground fault interrupter receptacles shall have the following features:
 - 1. UL listed: UL 943 Class A
 - 2. Configuration: Duplex, NEMA 5-20R
 - 3. Trip Current: 5 plus or minus 1 milliampere
 - 4. Trip Speed: 0.025 second maximum
 - a. Front-accessible test and reset pushbuttons
 - b. Manufacturer and type (or approved equal):
 - 1) Harvey Hubbell, Inc.: GP5362
 - 2) Pass & Seymour, Inc.: 2091
 - 3) Slater: SIR-20-F

2.4 PENDANT CORD/CONNECTOR DEVICES

- A. Description: Matching, locking type, plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy-Duty grade.
 - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.5 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 SWITCHES

- A. Provide totally enclosed, 20 Ampere, 120/277 Volt, quite AC general-use snap switches.
- B. Switches shall be single pole, double pole, three-way, four-way, locking or with pilot light as indicated on the drawings.
- C. Switches shall be specification grade, Bryant "4900" series, Hubbell "1220" series, P& S "20AC" series, G.E. "5950" series, Sylvania "1221A" series or Slater "720" series (or approved equal).
- D. Switch color shall be ivory in finished areas and brown in unfinished areas.

2.7 WALL PLATES

- A. Provide wall plates for single and combination wiring devices of types, sizes, and ganging, and cutouts as indicated.
- B. Sectional wall plates shall not be used. Select plates which mate and match wiring devices to which attached.
 1. Plate securing screws: Metal with head color to match plate finish.
 2. Material for finished spaces: Smooth, high impact thermoplastic, color of ivory.
 3. Material for unfinished spaces: Stainless steel.

3- EXECUTION

3.1 INSTALLATION

- A. All work shall be in accordance with NEC and OSHA requirements.
- B. Install devices and assemblies plumb and secure.
- C. Install wall plates when painting is complete.
- D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- E. Protect devices and assemblies during painting.

- F. Where adjacent to doors, coordinate with architectural drawings to ensure switches are installed on strike side of door.
- G. Locate switches approximately 48 inches (centerline) above finished floor elevation unless otherwise indicated.
- H. Locate receptacles approximately 18 inches (centerline) above finished floor elevation unless otherwise indicated.
- I. Install wiring devices only in electrical boxes which are clean (free from excess building materials, dirt, and debris).

3.2 IDENTIFICATION

- A. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
- B. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

- A. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- B. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Use Hubbel model HBL5200 or equal.
- B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.5 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140

SECTION 16721

FIRE DETECTION, ALARM AND RADIO TYPE REPORTING SYSTEM

1 GENERAL: This specification outlines requirements for modifications of the existing fire alarm monitoring and control equipment for Buildings 3420 and 3422 at Seymour Johnson Air Force Base at Goldsboro, North Carolina.

1.1 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. All publications shall be referred to in their latest edition, including any revisions thereof.

1. American National Standards Institute(ANSI)
ANSI C62.41 Recommended Practice for Surge Voltage in Low-Voltage AC Power Circuits
2. National Fire Protection Association (NFPA)
NFPA 70 National Electrical Code
NFPA 72 National Fire Alarm Code
NFPA 78 Lightning Protection Code
NFPA 90A Installation of Air Conditioning and Ventilation Systems
3. Underwriters Laboratories, Inc. (UL)
UL Directory Fire Protection Equipment Directory
UL 06 Rigid Metal Conduit
UL 38 Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
UL 268 Smoke Detectors for Fire Protective Signaling Systems
UL 268A Smoke Detectors for Duct Application
UL 464 Audible Signal Appliances
UL 521 Heat Detectors for Fire Protective Signaling Systems

UL 797 Electrical Metallic Tubing

UL 864 Control Units for Fire Protective Signaling Systems

- B. All work and equipment shall comply with applicable OSHA requirements, and with all applicable FCC requirements.

1.2 GENERAL REQUIREMENTS

- A. Products: The contractor shall replace existing Fire Lite alarm panel with a new fire alarm control panel (FACP), reconnect existing devices and add new initiating devices, alarm indicating appliances, and high expansion foam release panel input signals. Interface new FACP with existing transceiver. Panel shall have, as a minimum, the following:
 - 1. Hardware Features:
 - a. Eighty (80) character alphanumeric, super twist liquid crystal display.
 - b. Twenty-four (24) indicating device circuits (IDCs), Style B, Class B.
 - c. Four (4) notification appliance circuits (NACs), Style Y, Class B.
 - d. Four (4) amp power supply/battery charger.
 - e. Power limited design.
 - f. Pluggable terminal blocks.
 - 2. Software Features:
 - a. Menu driven programming.
 - b. On-site programming custom labels.
 - c. Four operator access levels.
 - d. Historical event logs.
 - e. Circuit selectable alarm verification.
 - f. Walk test performance testing.
 - g. Selectable active status reminder.
 - 3. Additional Features:
 - a. Expansion modules as required.
 - b. Additional power supply as required.
 - 4. Certification:
 - a. UL, ULC listed.
 - b. FM approved.
- B. Provide new initiating and notification devices as detailed in the specifications and as shown on the drawings.
- C. Reconnect existing Monaco transmitter as required.
- D. Reconnect existing initiating and notification devices as required.

- E. Reconnect existing 120 volt power as required.
- F. Any additional modules required are to be purchased and installed by certified personnel.
- G. Verification 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 or authorized representative of any discrepancy before performing the work.
- H. Compliance: The fire detection and internal alarm system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed or FM approved or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.
- I. Manufacturer's Services: Services of a manufacturer's representative who is certified in the installation, maintenance, adjustment, operation and repair, of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, programming, testing and certification of the equipment.
- J. Delivery and Storage: All equipment delivered and placed in storage shall be protected from the weather, humidity and temperature variations, dirt, dust, and other contaminants.
- K. Programming: Contractor is required to fully program the transceiver and the D-500 to communicate by zone and remote test.

1.3 SYSTEM DESIGN

- A. Operation: Existing fire alarm devices will remain and shall be wired to the new Fire Alarm Control Panel. New fire alarm devices will be added and system will continue to be a complete, supervised fire alarm system to maintain system integrity. The system is activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until any initiating device is reset and the fire alarm control panel is manually reset and restored to normal. Electrical supervision shall match existing and be in accordance with NFPA 72. All circuits shall be capable of operating under a single ground or open condition, as specified in NFPA 72. All textual, audible and visual devices and systems shall comply with NFPA 72.
- B. Operational Features. The existing system shall be modified to accommodate additional pull stations and alarm indicating devices as shown on drawing:
 - 1. Alarm initiating (zone) circuits for connection of detection devices shall match class of existing alarm initiating (zone) circuits.
 - 2. Auxiliary zone circuits for connection of non-powered alarm initiating devices such as tamper switches, heat detectors or manual pull stations.
 - 3. Alarm indicating (bell) circuits for connection of audible and visual alarm

evacuation signaling devices shall match class of existing alarm indicating circuits.

4. Zone programming capability which allows entry of a zone identification number, thirteen character description and type. Each zone is programmed for standard, supervisory, verification, positive alarm sequence, or water-flow warm operation; the auxiliary zones may also be programmed for tamper or for publicly accessible manual pull station.
5. Zones for alarm initiating circuits shall be arranged as indicated on the contract drawings.
6. Alarm functions. An alarm condition on a circuit shall automatically initiate the following functions:
 - a. Transmission of a signal (by zone and general alarm/general trouble) over the station fire reporting system.
 - b. Visual indication of the alarmed zone on the fire alarm control panel annunciator..
 - c. Continuous sounding of alarm indicating devices throughout the building.
 - d. Operation of the smoke control system.
 - e. Deactivation of the air handling, exhaust fans units throughout the building.

1.4 SUBMITTALS

- A. Installer Qualification. Installer must have five years experience in the installation of fire alarm systems and possess a minimum LEVEL II certificate from the NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET) in the sub-field FIRE PROTECTION ENGINEERING TECHNOLOGY (FIRE ALARM SYSTEMS). No fire alarm work is to be done with non-certified personnel (ie. electrician, helper, etc.)
- B. Shop Drawings. Shop drawings shall be submitted and shall consist of a complete set of equipment and materials, including manufacturer's descriptive and technical literature; performance charts and curves; catalog cuts; and installation instructions. Detail 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 anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.
- C. Test Reports. Upon completion and testing of the installed system, test reports shall be submitted in booklet form showing all field tests performed to prove

compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

D. Operation and Maintenance Manuals.

1. The contractor shall furnish the Contracting Officer or authorized representative three complete copies of operating instructions outlining step-by-step procedures required for system start up, operation and shut down. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features.
2. The contractor shall furnish the Contracting Officer or authorized representative three 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 system installed.

E. Spare Parts Data. After approval of the shop drawings 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 supplied, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 3 years of service.

F. As Built Drawings. PRIOR TO PERFORMANCE AND ACCEPTANCE TESTING, The contractor shall submit two legible copies of all fire alarm drawings showing the "as-built" system. The detail drawings of the fire detection system shall be signed by a Fire Protection Engineer. The drawings shall consist of a complete list of equipment and material, including manufacturer's descriptive and technical literature and catalog cuts. The drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. The detailed point-to-point wiring diagram showing all points of connection shall include connections between system devices, appliances, control panels, supervised devices, and all equipment that is activated by the control panel.

G. Certificates of Completion. PRIOR TO PERFORMANCE AND ACCEPTANCE TESTING, a Certificate of Completion per NFPA 72 shall be given to the Contracting Officer or authorized representative. "NOTE" The individual signing the certificate is warranting that the fire alarm system has been installed per NFP, NEC, UL and Air Force specifications and codes.

1.5 OVER VOLTAGE 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 requirements of ANSI C62.41. Surge protector shall be a Delta LA 301 or equal.

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, any other contaminants.

2 - PRODUCTS

2.1. Manual Fire Alarm Stations:

- A. Manual fire alarm stations shall conform to the applicable requirements of the UL 38. Manual stations shall be connected into alarm initiating circuits. Stations shall be single action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a 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. Where boxes must be surface mounted, boxes shall be painted the same color as the fire alarm manual stations. All manual pull stations located in the public areas shall have clear shield protective tamper cover placed over them.
- B. Heat detectors shall be as indicated. Detector, shall be rated for a minimum of 50 foot spacing (smooth ceiling rated) in accordance with UL521. Detector coverage shall be 2500 square feet minimum, with a maximum of 25 feet from the wall. Detector shall have screw terminals for making all wiring connections. Detector shall have LED lamp indicator.
 - 1. Fixed temperature detectors shall be outlet box mounted and supported independently of wiring connections. Detectors located in the mechanical/electrical room, kitchen or other areas with unconditioned air shall be rated for 200 degrees F.
 - 2. Combination Fixed-Temperature and Rate of Rise Detectors shall be outlet box mounted and supported independently of wiring connections. Contacts shall be self-resetting after response to rate of rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible.
- C. Temperature Monitoring System.
 - 1. Provide a system of temperature sensors for the aircraft servicing area in all geographic areas having a 99.6% dry bulb temperature less than -1 degree C (30 degrees F) when wet pipe sprinkler systems are present. The temperature sensors will be located at the same level as the sprinkler piping and spaced not more than 60 meters (200 feet) apart. Provide this temperature monitoring to ensure a warning when freezing temperatures endanger sprinkler piping.
 - 2. This facility temperature monitoring system will be tied into the FACP as a dedicated supervisory zone, and this supervisory signal will be

transmitted to the fire department in the same manner as all fire-related supervisory signals in the facility.

2.2 NOTIFICATION APPLIANCES

- A. Audible appliances shall be heavy duty and conform to the applicable requirements of UL 464. Devices shall be connected into alarm indicating circuits. All devices shall have separate screw terminals for each conductor.
- B. Combination Audible/Visual Notification Appliances. Combination audible/visual appliances shall be factory assembled. Units shall be suitable for use in an electrically supervised circuit and shall have a sound output rating of at least 85 dBA at 10 feet. Visual indication shall be accomplished by high intensity optic lens and flash tubes.

2.3 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

- A. Conduit shall comply with UL 06 and UL 797.
- B. Wiring. All wiring shall be copper. Wiring for strobe light circuits shall be No. 14 AWG minimum. Wiring for 120 v AC power shall be No. 12 AWG minimum. Wiring for power limited circuits shall be No. 14 AWG minimum/Power wiring and control wiring shall be isolated. All wiring shall conform to NFPA 70. All conductors shall be color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections are unacceptable.

3 - EXECUTION

3.1 INSTALLATION

- A. All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified.
- B. Wiring. Wiring for systems shall be installed in 1/2 inch minimum diameter conduit; however the wiring for the fire alarm system shall not be installed in conduits, junction boxes with conductors of lighting and power systems. No more than one conductor shall be installed under any screw terminal. All circuits conductors entered 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. The use of wire nut type connectors are prohibited in the system. 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 wiring to the control panel.
- C. Painting. All junction boxes shall be painted red.
- D. Notification Appliances. Devices shall be mounted 6 feet 8 inches above the finished floor elevation, or 6 inches below finished ceiling, if limited by ceiling height.
- E. Grounding. Grounding shall be provided to building ground.

- F. Manual Pull Stations shall be installed at approximately 4 feet (center) above finished floor elevation unless otherwise indicated.

3.2 TESTING

- A. The contractor shall notify the Contracting Officer or authorized representative 30 days before the performance and acceptance tests on new fire alarm devices are to be conducted. Existing fire alarm devices are not subject to testing. The Contractor shall provide battery calculations for the fire alarm system to the Contracting Officer or authorized representative 30 days prior to the acceptance test. The test shall be performed in the presence of the Contracting Officer or authorized representative under the supervision of the fire alarm system manufacturer's qualified representative. The contractor shall furnish all instruments, equipment 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 new initiating and notification appliance. Tests shall include the meggering of all system conductors to determine that the system is free from grounded, shorted and open circuits. The megger test shall be conducted prior to the installation of new 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 that 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 include the following functions as applicable to the circuits modified or added:
 - 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. Test of each alarm notification appliance.
 - 6. Test of the battery charger and batteries.
 - 7. Complete operational test under emergency power supply.
 - 8. Visual inspection of all wiring connections.
 - 9. Opening the circuit at each alarm initiating and indicating device to test the wiring supervisory feature.
 - 10. Verification of the as-built drawings to insure that they are correct.

3.3 TRAINING

- A. The contractor shall arrange for systems vendor to conduct system/equipment operation training for new equipment. Training session shall be of 4 hours for each major system/subsystem. The contractor shall notify the Contracting Officer or authorized representative 30 days before the training session is to be conducted.

END OF SECTION 16721

SCHEDULE OF MATERIAL SUBMITTALS												PROJECT NUMBER VKAG 98-1125		PROJECT TITLE REPAIR FIRE SUPPRESSION, BLDG. 4909		SOLICITATION/CONTRACT NUMBER				
TO BE COMPLETED BY PROJECT ENGINEER												TO BE COMPLETED BY CONTRACT ADMINISTRATOR								
LINE NUMBER	ITEM OR DESCRIPTION OF ITEM, CONTRACT REFERENCE, TYPE OF SUBMITTAL	NUMBER OF COPIES REQUIRED										DATE RECEIVED IN CONTRACTING	DATE TO CIVIL ENGINEERING	RETURN SUSPENSE	SUBMITTAL NUMBERS	DATE CONTRACTOR NOTIFIED		CONTRACTOR RE-SUBMITTAL	FINAL APPROVAL	REMARKS
		CERTIFICATION OF COMPLIANCE	SHOP DRAWINGS	SAMPLES	COLOR SELECTION	MANUFACTURER'S RECOMMENDATIONS	MANUFACTURER'S WARRANTY	CATALOG DATA	OPERATING INSTRUCTIONS	OTHER	SUBMITTAL CODE					REQUIRED SUBMISSION DATE	APPROVED			
49	13916 PARA 1.1, D.2 PIPE COUPLINGS						3					A								
50	13916 PARA 1.1, D.2 SPRINKLER HEADS						3					A								
51	13916 PARA 1.1, D.3 SPRINKLER DRAWINGS		3									A								
52	13916 PARA 1.1, D.4 CONTRACTOR'S MATERIAL & TEST CERTIFICATE FOR ABOVE GROUND	3										A								
53	13916 PARA 1.1, D.4 PURGING & DISINFECTING REPORTS	3										B								
54	13916 PARA 1.1, D.4 HYDROSTATIC TEST	3										B								
55	13916 PARA 1.1, D.5 ALARM VALVE								3			A								
56	13956 PARA 1.4.A PIPE								3			A								
57	13956 PARA 1.4.A PIPE FITTINGS								3			A								
58	13956 PARA 1.4.A PIPE COUPLINGS								3			A								
59	13956 PARA 1.4.A GATE VALVE								3			A								
60	13956 PARA 1.4.A ALARM VALVES								3			A								

SCHEDULE OF MATERIAL SUBMITTALS												PROJECT NUMBER VKAG 98-1125		PROJECT TITLE REPAIR FIRE SUPPRESSION, BLDG. 4909			SOLICITATION/CONTRACT NUMBER			
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85	13956 PARA 1.4.K OPERATION & MAINTENCE MANUALS								3			B								
86	15446 PARA 1.2, A SUMP PUMP							3				A								
87	15446 PARA 1.2, B SUMP PUMP		3									A								
88	15446 PARA 1.2, C SUMP PUMP							3				A								
89	16060 PARA 1.3.A. GROUNDING AND BONDING							3				A								
90	16120 PARA 1.2.A. CONDUCTORS AND CABLES							3				A								
91	16130 PARA 1.2.A. RACEWAYS AND BOXES							3				A								
92	16140 PARA 1.3.A. WIRING DEVICES							3				A								
93	16721 PARA 1.4.A FIRE DETECTION, ALARM & RADIO TYPE REPORTING SYS.									3		A								
94	16721 PARA 1.4.B FIRE DETECTION, ALARM & RADIO TYPE REPORTING SYS.		3									A								
95	16721 PARA 1.4.C FIRE DETECTION, ALARM & RADIO TYPE REPORTING SYS.									3		B								
96	16721 PARA 1.4.D FIRE DETECTION, ALARM & RADIO TYPE REPORTING SYS.									3		A								

SEYMOUR JOHNSON

Air Force Base

Goldsboro, North Carolina

SPECIFICATIONS

FOR

DATE: April 20, 2001

PROJECT TITLE: INSTALL FIRE SUPPRESSION, ATC
STORAGE, BLDG. 3420 AND BLDG. 3422

PROJECT NO: VKAG 99-1159

PROJECT MANAGER: LT SHANNON EASTERLING



100%

CORRECTED
DOCUMENTS

**SEYMOUR JOHNSON AIR FORCE BASE
INSTALL FIRE SUPPRESSION
ATC STORAGE
BLDG. 3420 AND BLDG. 3422
PROJECT No. VKAG 99-1159**

SPECIFICATIONS

DIVISION 1	GENERAL REQUIREMENTS
01000	GENERAL
01560	ENVIRONMENTAL PROTECTION
DIVISION 2	SITE CONSTRUCTION
02070	SELECTIVE DEMOLITION
02300	EARTHWORK
02510	WATER DISTRIBUTION
02511	HOT-MIX ASPHALT PAVING
02530	SANITARY SEWERAGE
02920	LAWNS AND GRASSES
DIVISION 3	CONCRETE
03300	CAST-IN-PLACE CONCRETE
DIVISION 4	MASONRY
04810	UNIT MASONRY ASSEMBLIES
DIVISION 5	METALS
05210	STEEL JOISTS
05310	STEEL DECK
DIVISION 6	WOOD AND PLASTICS
06105	MISCELLANEOUS CARPENTRY
DIVISION 7	THERMAL AND MOISTURE PROTECTION
07610	STANDING SEAM METAL ROOFING
07841	THROUGH-PENETRATION FIRESTOP SYSTEMS
07920	JOINT SEALANTS
DIVISION 8	DOORS AND WINDOWS
08110	STEEL DOORS AND FRAMES
08711	DOOR HARDWARE (SCHEDULED BY NAMING PRODUCTS)
DIVISION 9	FINISHES
09260	GYPSUM BOARD ASSEMBLIES
09653	RESILIENT WALL BASE AND ACCESSORIES
09900	PAINTING
DIVISION 13	SPECIAL CONSTRUCTION
13916	FIRE-SUPPRESSION SPRINKLERS
13921	ELECTRIC-DRIVE, HORIZONTAL FIRE PUMPS

**SEYMOUR JOHNSON AIR FORCE BASE
INSTALL FIRE SUPPRESSION
ATC STORAGE
BLDG. 3420 AND BLDG. 3422
PROJECT No. VKAG 99-1159**

DIVISION 16	ELECTRICAL
16002	ELECTRICAL GENERAL PROVISIONS
16060	GROUNDING AND BONDING
16120	CONDUCTORS AND CABLES
16124	MEDIUM VOLTAGE DISTRIBUTION POWER CABLES
16130	RACEWAYS AND BOXES
16140	WIRING DEVICES
16182	FUSES, MEDIUM AND HIGH VOLTAGE
16350	MEDIUM-VOLTAGE TRANSFORMERS
16442	PANELBOARDS
16460	LOW VOLTAGE TRANSFORMERS
16515	INTERIOR LIGHTING FIXTURES
16721	FIRE DETECTION, ALARM, AND RADIO TYPE REPORTING SYSTEM

SECTION 01000

GENERAL

- 1.1 SCOPE OF WORK: The work covered by this specification consists of furnishing all plant, labor, equipment and material, and performing all work in connection with VKAG 99-1159, INSTALL FIRE SUPPRESSION, ATC STORAGE, BLDG. 3420 & BLDG. 3422 in strict accordance with these specifications and drawings and subject to the terms and conditions of this contract.
- 1.2 LOCATION: The work is to be accomplished at Seymour Johnson Air Force Base, Goldsboro, North Carolina. This base is accessible by both public highway and railway.
- 1.3 WORKWEEK: The contractor shall observe the same regular workweek being observed by the Seymour Johnson AFB Civil Engineering shop forces, which is 7:30 a.m. to 4:30 p.m., Monday through Friday, with Federal holidays excluded. Any deviation from this schedule will require 48 hours advance notice and approval of the Contracting Officer.
- 1.4 PRINCIPLE FEATURES: The work covered by this contract includes, but is not limited to the following:
- A. Fire Suppression Sprinklers, Fire Alarm System, Pump House, and Construct Heated Room within Unheated Building.
- 1.5 HAUL ROUTES: The Contractor shall use the haul routes indicated on the plans.
- 1.6 DISPOSITION OF NONSALVAGEABLE MATERIALS: All nonsalvageable or unusable material shall be disposed of off base as directed by the Contracting Officer. All waste material generated by any work under this contract shall be handled, transported, stored, and disposed of off base, by the Contractor, in accordance with all applicable federal, state, or local laws, ordinances, regulations, court orders, or other types of rules or rulings having the effect of law.
- 1.7 SUBMITTALS REQUIRED: Required submittals are listed on AF Form 66.
- 1.8 BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST, AF FORM 103: The Contractor shall obtain AF Form 103, Base Civil Engineering Work Clearance Request, prior to work commencement from the Contract Management Section in Bldg 3300, 1095 Peterson Avenue. Upon receipt of an AF Form 103, the Contractor shall be responsible for locating all base owned underground utilities, as well as, coordinating local utility companies to stake out utilities if not owned by the base. Historical drawings, as-built drawings, and topographic drawings are available for review at the 4th Civil Engineer Squadron, Design element located in Building 3300. Base owned

utilities include but are not limited to electric, water, sewer, steam, communication, telephone, fiber optic, cathodic protection, and fuel lines. Utilities not owned by the base include but are not limited to cable TV, Southern Bell Telephone, and Natural Gas. The Contractor shall contact ULOCO and the non-base utility companies for location services. In the event that the Contractor damages a utility which is commented in the plans, record drawings, or located by a utility locator, the Contractor shall repair/replace the utility at no additional cost to the Government. Utilities not documented, shown, or located by a locator shall be considered abandoned or unknown. Contractor damage to unknown or abandoned utilities shall be dealt with as a differing site condition.

- 1.9 SAFETY: All safety requirements of the U.S. Army Corps of Engineers Safety Manual 385-1-1 dated October 1996 will be strictly adhered to as related to all work covered under these specifications.
- 1.10 MATERIALS CONTAINING ASBESTOS: In the event the Contractor discovers materials suspected of containing asbestos that is not identified to be removed in the plans and specifications, the Contractor shall notify the Contracting Officer. The Contractor's work shall proceed unless the materials suspected of containing asbestos are damaged or disturbed. Any suspected materials damaged or disturbed by the Contractor without permission from the Contracting Officer shall be removed by the Contractor at his expense IAW all applicable Federal, State, and local laws, ordinances, regulations, court orders, or other types of rules or rulings having the effect of law.
- 1.11 LABELING OF STORAGE DRUMS: All 55 gallon or larger drums brought on base for use under this contract and containing new material or used for storage of waste materials or hazardous waste must be labeled with a Department of Transportation (DOT) Proper Shipping Name, DOT Hazardous Identification Number, the Contractor's name, a Contractor representative, and the Contractor's telephone number. Label lettering should have a minimum height of one half inch painted in white paint or other color that is in contrast with the color of the drum. The label should be sufficiently durable to equal or exceed the life (including storage and disposal) of the drum.
- 1.12 CONTRACTOR STORAGE TRAILER(S) AND BUILDING(S): The Contractor shall place or paint a sign on all of his storage trailer(s) and building(s) used on this contract. At a minimum, the sign shall contain the name of the Contractor and a telephone number at which the Contractor can be reached. The trailer(s) and building(s) shall be complete with gates and/or doors which can be locked. Only material for this project shall be stored in the trailer(s) or building(s). The Contractor shall remove the storage trailer(s) or building(s) within 30 days after completion of the contract and prior to submitting his final invoice. The area around the storage trailer(s) and building(s) shall be kept clean. This includes the mowing of grass during the growing season. The lawn mower shall be supplied by the Contractor.
- A. The Contractor will be given a lot in the Contractor Storage Area behind Bldg 2700 for the life of the contract. The Contractor's progress schedule shall include a line item

(equal to 1%) for final cleanup of this storage lot. Final payment will not be made until this final cleanup is performed by the Contractor and accepted by Seymour Johnson AFB.

1.13 PHASING:

- A. The 30 days following Contractor's Notice to Proceed (Phase I) will be allowed for delivery of materials, equipment ordering, and submittal approval only. No on-site work shall be permitted by the Contractor during that initial 30 day period.
- B. After the submittal phase, the performance period (Phase II) will take 90 days.

1.14 AFFIRMATIVE PROCUREMENT:

- A. The contractor shall incorporate Affirmative Procurement requirements as per 40 CFR, Part 247 and Executive Order 13101: "Greening the Government Through Waste Prevention, Recycling and Federal Acquisition." Designated items used in the execution of this contract shall meet or exceed the Environmental Protection Agency's (EPA) requirements for recycled content materials (RCM) as per the EPA's Comprehensive Procurement Guidelines (CPG). The contractor/engineer shall ensure affirmative procurement requirements for CPG items are met or provide written justification that: 1) The price of a given designated item is unreasonably high, 2) There is inadequate competition (not enough sources of supply), 3) Unusual and unreasonable delays would result from obtaining the item, or 4) The item does not meet the Air Force's performance specifications.

END OF SECTION 01000

SECTION 01560

ENVIRONMENTAL PROTECTION

1.1 DEFINITIONS OF CONTAMINANTS:

- A. Sediment: Soil and other debris that has been eroded and transported by runoff water.
- B. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations, and from community activities.
- C. Rubbish: A variety of combustible and noncombustible wastes such as paper, boxes, glass, crockery, metal, lumber, cans, and bones.
- D. Debris: Includes combustible and noncombustible wastes, such as ashes, waste materials that result from construction or maintenance and repair work, leaves, and tree trimmings.
- E. Chemical Wastes: Includes salts, acids, alkalies, herbicides, pesticides, and organic chemicals.
- F. Sanitary Waters:
 - 1. Sewage: Wastes characterized as domestic sanitary sewage.
 - 2. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.
- G. Oily Waste: Includes petroleum products and bituminous materials.

1.2 ENVIRONMENTAL PROTECTION REQUIREMENTS: Provide and maintain during the life of the contract, environmental protection as defined herein. Provide environmental protection measures as required to control pollution that develops during normal construction practice. Provide also environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with all federal, state, and local regulations pertaining to water, air, and noise pollution. Develop proposals for an environmental protection plan for the project and, prior to the commencement of the work, meet with the Contracting Officer and discuss the proposed environmental protection plan. The meeting shall develop mutual understanding relative to details of environmental protection, including measures for protecting natural resources, required reports, and measures to be taken should the Contractor fail to provide adequate protection in an adequate and timely manner. Perform a preconstruction survey of the project site to enhance the survey.

1.3 PROTECTION OF NATURAL RESOURCES: The natural resources within the project boundaries and outside the limits of permanent work performed under this contract shall be preserved in their existing condition or restored to an equivalent or improved condition upon completion of the work.

- A. Land Resources: Except in areas indicated to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without special permission from the Contracting Officer. Do not fasten or attach ropes, cables, or guys to any existing nearby trees for anchorages unless specifically authorized. Where such special emergency use is authorized, the Contractor shall be responsible for any resultant damage.
 - 1. Protection: Protect existing trees which are to remain and which may be injured, bruised, defaced, or other wise damaged by construction operations.
 - 2. Repair or Restoration: Repair or restore to their original condition all trees or other landscape features scarred or damaged by the equipment or operations. Obtain approval of the repair or restoration from the Contracting Officer prior to its initiation.
 - 3. Temporary Construction: Obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and all other vestiges of construction. Temporary roads, materials, and all other vestiges of construction. Temporary roads, parking areas, and similar temporary use areas shall be graded in conformance with surrounding areas, tilled, and seeded. Include topsoil of nutriment during the seeding operation as necessary to reestablish a suitable stand of grass.

- B. Water Resources: Perform all work in such a manner than any adverse environmental impact on water resources is reduced to a level acceptable to the Contracting Officer.
 - 1. Oily Substances: Take special measures to prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. Surround all temporary fuel oil, petroleum, or liquid chemical storage tanks with a temporary earth berm of sufficient size and strength to contain the contents of the tanks in the event of content leakage of spillage.

- C. Fish and Wildlife Resources: During the performance of the work take such steps as required to prevent interference or disturbance to fish and wildlife. Do not alter water flows or otherwise significantly disturb native habitat adjacent to the project area which are critical to fish and wildlife except as may be indicated or specified.

1.4 EROSION AND SEDIMENT CONTROL MEASURES:

- A. Burn-off: Burn-off of ground cover is not permitted.
- B. Protection of Erodible Soils: All earthwork brought to final grade shall be immediately finished as indicated or specified. Protect immediate side slopes and backslopes upon completion of rough grading. Plan and conduct all earthwork in such a manner as to minimize the duration of exposure of unprotected soils.
- C. Temporary Protection of Erodible Soils. Utilize the following methods to prevent erosion and control sedimentation.
 - 1. Mechanical Retardation and Control of Runoff. Mechanically retard and control the rate of runoff from the construcion site. This includes construction of

diversion ditches, benches, and berms, to retard and divert runoff to protected drainage courses.

2. Sediment Basins: Trap sediment in temporary sediment basins. Select basin size to accommodate the runoff of a local 5 year storm. Pump dry and remove accumulated sediment after each storm. Use a paved weir or vertical overflow pipe for overflow. Remove collected sediment from the site. Institute effluent quality monitoring programs as required by state and local environmental agencies.
3. Vegetation and Mulch: Provide temporary protection on all side and back slopes as soon as rough grading is completed or sufficient soil is exposed to require protection to prevent erosion. Such protection shall be by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding or such combination of these and other methods necessary for effective erosion control.

1.5 CONTROL AND DISPOSAL OF SOLID, CHEMICAL, AND SANITARY WASTES: Pick up solid wastes and place in containers which are emptied by the contractor on a regular schedule. The preparation, cooking, and disposing of food are strictly prohibited on the project site. Conduct handling and disposal of wastes to prevent contamination of the site and other areas. On completion, leave areas clean and natural looking. Obliterate signs of temporary construction and activities incidental to construction of the permanent work in place.

A. Disposal of Rubbish and Debris: Dispose of rubbish and debris in accordance with the requirements specified herein.

1. Removal from Government Property: Remove rubbish and debris from Government property and dispose of it in compliance with federal, state, and local requirements.
2. Chemical Waste: Store chemical waste in corrosion resistant containers labeled to identify type of waste and date filled. Remove containers from the project site, and dispose of chemical waste in accordance with federal, state, and local regulations. For oil and hazardous material spills which may be large enough to violate federal, state, and local regulations, notify the Contracting Officer immediately.
 - a. Petroleum Products: Conduct fueling and lubricating of equipment and motor vehicles in a manner that affords the maximum protection against spills and evaporation. Dispose of lubricants to be discarded and excess oil in accordance with approved procedures meeting federal, state, and local regulations.

1.6 DUST CONTROL: Keep dust down at all times, including non-working hours, weekends, and holidays. Sprinkle or treat, with dust suppressors, the soil at the site, haul roads, and other areas disturbed by operations. No dry power brooming is permitted. Instead use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air Blowing is permitted only for cleaning nonparticulate debris, such as steel reinforcing bars. No sandblasting is permitted unless dust therefrom is confined. Only wet cutting of concrete blocks, concrete, and asphalt is permitted. No

unnecessary shaking of bags is permitted where bagged cement, concrete mortar and plaster is used.

- 1.7 NOISE: When available, make the maximum use of “low-noise-emission products” as certified by EPA. No blasting or use of explosives is permitted.

END OF SECTION 01560

SECTION 02070
SELECTIVE DEMOLITION

1.1 GENERAL

A. Definitions:

1. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
2. Remove and Salvage: Detach items from existing construction and deliver them to the Government.
3. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
4. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. 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 Contractor's property and shall be removed from Project site.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Project Conditions:

1. The Government will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so the Government 's operations will not be disrupted. Provide not less than 48 hours' notice to the Government of activities that will affect the Government 's operations.
2. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
3. the Government assumes no responsibility for condition of areas to be selectively demolished.
 - a. Conditions existing at time of inspection for bidding purpose will be maintained by the Government as far as practical.

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

G. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

1.2 PRODUCTS

- A. Repair Materials: Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.

1.3 EXECUTION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- B. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to the Contracting Officer or authorized representative.
- C. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- E. Utility Requirements: Locate, identify, disconnect, shut off, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 1. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
- F. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- G. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
- H. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

- I. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
- J. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- K. Temporary Shoring: Provide and maintain interior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- L. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
- M. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- N. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.
- O. Selective Demolition: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. 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.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. 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.
 - 4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- P. Removed and Salvaged Items: Comply with the following:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to the Government.
 - 4. Protect items from damage during transport and storage.

- Q. Removed and Reinstalled Items: Comply with the following:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- R. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Contracting Officer or authorized representative, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- S. Patching and Repairs: Promptly repair damage to adjacent construction caused by selective demolition operations.
1. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 2. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
- T. Disposal of Demolished Materials: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
1. Burning: Do not burn demolished materials.
 2. Disposal: Transport demolished materials off the Government's property and legally dispose of them.

END OF SECTION 02070

SECTION 02300

EARTHWORK

1.1 GENERAL

A. Definitions in this Section include the following:

1. Backfill: Soil materials used to fill an excavation.
2. Base Course: Layer placed between the subbase course and asphalt paving.
3. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
4. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
5. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
6. Excavation: Removal of material encountered above subgrade elevations.
7. Fill: Soil materials used to raise existing grades.
8. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
9. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.
10. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
11. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Government or others unless permitted in writing and then only after arranging to provide temporary utility services according to requirements indicated.

1.2 PRODUCTS

- A. Soil Materials: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
- D. Backfill and Fill: Satisfactory soil materials.

- E. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- F. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- G. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.
- H. Detectable Warning Tape: Polyethylene film warning tape encasing a metallic core, minimum 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility.

1.3 EXECUTION

- A. 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.
- B. Provide erosion- and sedimentation-control measures.
- C. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- D. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
- E. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- F. Excavate for structures, pavements, and walks to indicated elevations and dimensions. Extend excavations for placing and removing concrete formwork, for installing services and other construction, and for inspections. Trim bottoms to required lines and grades to leave solid base to receive other work.
- G. Excavate utility trenches to indicated gradients, lines, depths, and invert elevations of uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit.

1. Excavate trenches deeper than bottom of pipe elevation, 6 inches (150 mm) deeper in rock, 4 inches (100 mm) deeper elsewhere, to allow for bedding course. Hand excavate for bell of pipe.
- H. Proof roll subgrades, before filling or placing aggregate courses, with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.
- I. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities.
- J. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by the Contracting Officer or authorized representative.
- K. Stockpile borrow materials and satisfactory soil materials, without intermixing, in shaped, graded, drained, and covered stockpiles. Stockpile soil materials away from edge of excavations and outside drip line of remaining trees.
- L. Utility Trench Backfill: Place, compact, and shape bedding course to provide continuous support for pipes and conduits over rock and other unyielding bearing surfaces and to fill unauthorized excavations.
1. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit. Place and compact final backfill of satisfactory soil material to final subgrade.
 2. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.
- M. Fill: Place and compact fill material in layers to required elevations.
- N. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
1. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
- O. Compaction: Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- P. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 92 percent.
 3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 85 percent.
- Q. Grading: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated. Grade lawns, walks, and unpaved subgrades to tolerances of plus or minus 1 inch (25 mm) and pavements and areas within building lines to plus or minus 1/2 inch (13 mm).
- R. Subbase and Base Courses: Under pavements and walks, place subbase course on prepared subgrade. Place base course material over subbase. Compact to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
- S. Under slabs-on-grade, place drainage course on prepared subgrade. Compact to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
- T. Testing Agency: The Contractor will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
1. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
 2. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.
- U. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction.
- V. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
- W. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Government's property.

END OF SECTION 02300

SECTION 02510

WATER DISTRIBUTION

1.1 GENERAL

- A. Comply with requirements of utility supplying water.
- B. Comply with standards of authorities having jurisdiction for water-service piping.
- C. Comply with NSF 61 for materials for potable water.
- D. Provide listing/approval stamp, label, or other marking on piping and specialties made to specified standards.
- E. Submittals: Submit the following:
 - 1. Product Data: For valves (NRS, OS&Y), tapping sleeve and valve, underground piping materials and fittings, post indicator, back flow prevention device, and prefabricated vault.
 - 2. Approved Site Plan Drawings: Working plans, prepared according to NFPA 13 and 24 that have been approved by authorities having jurisdiction.
 - 3. Field test reports and certificates: Include "Contractor's Material and Test Certificate for Underground Piping", purging and disinfecting reports, and hydrostatic test.
 - 4. Warranty: Provide manufacturer's written warranty for pipe.
 - 5. Provide operating and test instructions for the backflow preventer.

1.2 PRODUCTS

- A. Pipes and Tubes: Applications of the following pipe and tube materials are indicated in "Piping Applications" Paragraph.
 - 1. Ductile-Iron, Push-on-Joint Pipe: AWWA C151, with cement-mortar lining and seal coat. Include rubber compression gasket.
- B. Pipe and Tube Fittings: Applications of the following pipe and tube fitting materials are indicated in "Piping Applications" Paragraph.
 - 1. Ductile-Iron, Push-on-Joint Fittings: AWWA C110, ductile-iron or cast-iron; or AWWA C153, ductile-iron, compact type. Include cement-mortar lining, seal coat, and rubber compression gaskets.
- C. Joining Materials: Applications of the following piping joining materials are indicated in "Piping Applications" Paragraph.
 - 1. Ductile-Iron Piping: The following materials apply:
 - a. Push-on Joints: AWWA C111 rubber gaskets and lubricant.

2. Pipe Couplings: Iron-body sleeve assembly, fabricated to match OD of pipes to be joined. Include sleeve, followers, gaskets, bolts and nuts, and enamel-paint finish.
- D. Nonrising-Stem Gate Valves, 4-Inch NPS (DN100) and Larger: UL 262, FM approved, iron body and bonnet with flange for indicator post, bronze seating material, inside screw, 175-psig (1200-kPa) working pressure, and mechanical-joint ends. Provide with flanged ends for pit installation.
 - E. Rising-Stem Gate Valves, 3-Inch NPS (DN80) and Larger: AWWA C509, resilient seated; cast-iron or ductile-iron body and bonnet, OS&Y, bronze stem, 200-psig (1380-kPa) working pressure, and flanged ends.
 - F. Nonrising-Stem Gate Valves, 2-Inch NPS (DN50) and Smaller: MSS SP-80; body and screw bonnet of ASTM B 62 cast bronze; with Class 125 threaded ends, solid wedge, nonrising copper-silicon-alloy stem, brass packing gland, PTFE-impregnated packing, and malleable-iron handwheel.
 - G. Valve Boxes: Cast-iron box with top section and cover with lettering "WATER," bottom section with base of size to fit over valve and barrel approximately 5 inches (125 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury of valve. Include steel tee-handle wrench with each valve box.
 - H. Double-Check-Detector Assembly Backflow Preventers: ASSE 1048, FM approved or UL listed, and suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet equipped with tamper switches connected to building fire alarm control panel. Include test cocks; two positive-seating check valves; and bypass with displacement-type water meter, valves, and double-check backflow preventer.
 1. Maximum Pressure Loss: 5 psig (35 kPa) through middle 1/3 of flow range.
 - I. CONCRETE VAULTS: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858. ASTM A 36/A 36M, steel or polyethylene-encased steel steps. Furnish with 4'-0" x 6'-0" double leaf, aluminum vault access door. Furnish with 2'-0" diameter gravel filled sump drain.
 - J. Exposed, Freestanding, Sidewalk, Fire Department Connections: UL 405, cast-bronze body, with thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch-(460-mm-) high brass sleeve; and round escutcheon plate.
 1. Connections: Two NPS 2-1/2 (DN 65) inlets and one NPS 4 (DN 100) outlet.
 2. Finish Including Sleeve: Rough chrome plated.
 3. Round, Floor, Brass, Escutcheon Plate Marking: "AUTO SPKR."
 - K. Indicator Posts: UL 789, FM-approved, vertical-type, cast iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of

burial valve. Provide tamper switch to be connected to building fire alarm control panel.

- L. Service Boxes for Curb Stops: Cast-iron box with telescoping top section of length required for depth of bury of valve. Include cover with lettering "WATER," and bottom section with base of size to fit over curb-stop and barrel approximately 3 inches (75 mm) in diameter. Include steel tee-handle shutoff rod with each service box.
- M. Ball Valves: AWWA C507, Class 250. Include interior coating according to AWWA C550.
- N. Tapping Sleeve and Tapping Valve: Complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. Use sleeve and valve compatible with tapping machine.
 - 1. Tapping Sleeve: Cast- or ductile-iron, 2-piece bolted sleeve with flanged outlet for new branch connection. Sleeve may have mechanical-joint ends with rubber gaskets or sealing rings in sleeve body. Include sleeve matching size and type of pipe material being tapped and of outlet flange required for branch connection.
- O. Anchorage Materials are as follows:
 - 1. Steel: ASTM A 506, clamps, straps, and washers; ASTM A 575, rods; and ASTM A 307, bolts.
 - 2. Iron: ASTM A 197 (ASTM A 197M), malleable-iron rod couplings and ASTM A 126, gray-iron washers.
 - 3. Concrete Reaction Backing (Thrust Blocks): Portland cement concrete mix, 3000 psig (20.7 MPa); with cement according to ASTM C 150, Type I; sand and crushed gravel according to ASTM C 33; and potable water. Minimum volume of thrust block shall be ½ c.y.
- P. Refer to Section 02300 "Earthwork" for underground warning tape materials. Arrange for warning tapes made of solid blue film with continuously printed black-letter caption "CAUTION--WATER LINE BURIED BELOW." Warning tape shall have integral metallic wire core.

1.3 EXECUTION

- A. Refer to Section 02300 "Earthwork" for excavation, trenching, and backfilling.
- B. Piping Applications: Use pipe, fittings, and joining methods for piping systems according to the following applications:
 - 1. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
 - 2. Fire-Protection Water-Service Piping: Use ductile-iron, push-on-joint pipe and fittings; and gasketed joints.

- C. Valve Applications: Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, 4-Inch NPS (DN100) and Larger: UL/FM, gate valves, nonrising stem, with indicator post.
 2. Pit Installation Valves, 2-1/2-Inch NPS (DN65) and Larger: UL/FM, OS&Y gate valves.
 3. Pit Installation Valves, 2-Inch NPS (DN50) and Smaller: MSS, nonrising-stem gate valves.
- D. Joint Construction:
1. Ductile-Iron Piping, Gasketed Joints for Fire-Service Piping: According to UL 194 and AWWA C600.
- E. Piping Systems - Common Requirements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.
1. Install fittings for changes in direction and branch connections.
 2. Piping Connections: Unless otherwise indicated, make piping connections as specified below:
 - a. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.
 - b. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
- F. Extend water-service piping and connect to water-supply source.
- G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- H. Terminate service-entry piping 12" above building finished floor.
- I. Piping Installation: Install piping according to the following:
1. Water-Main Connection: Tap water main with size and in location as indicated according to requirements of water utility.
 2. Make connections larger than 2-inch NPS (DN50) with tapping machine according to manufacturer's written instructions and AWWA C600. Install valve with stem pointing up and with cast-iron valve box.
 3. Comply with NFPA 24 for fire-protection water-service piping materials and installation.
 4. Install ductile-iron piping according to AWWA C600.

5. Bury piping with depth of cover over top at least 30 inches (750 mm), with top at least 12 inches (300 mm) below level of maximum frost penetration.
- J. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 1. Gasketed-Joint, Ductile-Iron, Fire-Service Piping: According to NFPA 24.
 2. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.
 - K. Valve Installation: Use mechanical-joint-end valves for 3-inch NPS (DN80) and larger underground installation. Use threaded- and flanged-end valves for installation in pits. Use nonrising-stem UL/FM gate valves for installation with indicator posts.
 1. AWWA-Type Gate Valves: Comply with AWWA C600. Install underground valves with stem pointing up and with cast-iron valve box.
 2. UL/FM-Type Gate Valves: Comply with NFPA 24. Install underground valves and valves in pits with stem pointing up and with vertical cast-iron indicator post.
 - L. Install precast concrete pits according to ASTM C 891.
 - M. Install fire department connections of types and features indicated.
 - N. Install continuous plastic underground warning tape during back-filling of trench for underground water-service piping. Locate 6 to 8 inches (150 to 200 mm) below finished grade, directly over piping.
 - O. Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system.
 - P. Hydrostatic Tests: Test at 200 psi for 2 hours. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within above limits.

1.4 CLEANING

- A. Flush, clean and disinfect water distribution piping as follows:
 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or as described below:

- a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
- b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
- c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
- d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 02510

SECTION 02511

HOT-MIX ASPHALT PAVING

1.1 GENERAL

- A. Submittals: Product Data, material certificates, and the following:
 - 1. Job-Mix Designs: For each job mix proposed for the Work.
- B. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- C. Manufacturer Qualifications: Manufacturer of hot-mix asphalt shall be a registered and approved paving mix manufacturer with authorities having jurisdiction or with the NCDOT.
- D. Regulatory Requirements: Conform to applicable standards of authorities having jurisdiction for asphalt paving work on public property.
- E. Asphalt-Paving Publication: Comply with AI's "The Asphalt Handbook," except where more stringent requirements are indicated.
- F. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
 - 1. Tack Coats: Minimum surface temperature of 60 deg F (15.5 deg C).
 - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.5 deg C) at time of placement.

1.2 PRODUCTS

- A. Coarse Aggregate: Sound; angular crushed stone; crushed gravel; or properly cured, crushed blast-furnace slag; complying with ASTM D 692.
- B. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone; gravel, properly cured blast-furnace slag, or combinations thereof; complying with ASTM D 1073.
- C. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D 242.
- D. Asphalt Cement: ASTM D 3381 for viscosity-graded material; ASTM D 946 for penetration-graded material.

- E. Tack Coat: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- F. Herbicide: Commercial chemical for weed control, registered by Environmental Protection Agency (EPA). Provide granular, liquid, or wettable powder form.
- G. Wheel Stops: Precast, air-entrained concrete, 2500-psi (17.2-MPa) minimum compressive strength, approximately 9-1/2 inches high, 12 inches wide, and 84 inches long. Provide chamfered corners and drainage slots on underside, and provide holes and galvanized steel dowels for anchoring to substrate.
- H. Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI's "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:
 - 1. Base Course: As indicated.
 - 2. Surface Course: As indicated.

1.3 EXECUTION

- A. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
 - 1. Before placing asphalt materials, remove loose and deleterious material from substrate surfaces.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions.
- C. Tack Coat: Apply uniformly to existing surfaces of previously constructed asphalt or portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface. Allow tack coat to cure undisturbed before paving.
 - 1. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Machine place base and surface courses of hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness, when compacted.
- E. Promptly correct surface irregularities in paving course behind paver. Remove excess material and fill depressions with hot-mix asphalt.
- F. Construct joints to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.

- G. Compact each hot-mix asphalt course to an average density of 96 percent of reference laboratory density according to ASTM D 1559, but not less than 94 percent nor greater than 100 percent, and to the following tolerances:
 - 1. Thickness: Base course, plus or minus 1/2 inch (13 mm); surface course, plus 1/4 inch (6 mm), no minus.
 - 2. Surface Smoothness: Base course, 1/4 inch (6 mm); surface course, 1/8 inch (3 mm).
- H. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt compacted by rolling to specified density and surface smoothness.
- I. Apply pavement-marking paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).
- J. Securely attach wheel stops into pavement with not less than 2 galvanized steel dowels embedded in precast concrete at one-third points. Firmly bond each dowel to wheel stop and to pavement.

END OF SECTION 02511

SECTION 02530
SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes sanitary sewerage outside the building.

1.2 PERFORMANCE REQUIREMENTS

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

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe.
- B. Field test reports.

1.4 PROJECT CONDITIONS

- A. Site Information: Perform site survey and verify existing utility locations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Paragraph for applications of pipe and fitting materials.

2.3 PIPES AND FITTINGS

- A. Hub-and-Spigot, Cast-Iron Soil Pipe and Fittings: ASTM A 74, gray iron, for gasketed joints.
 - 1. Gaskets: ASTM C 564, rubber, compression type, thickness to match class of pipe.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."
- B. Identification: Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.
 - 1. Use warning tape or detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.
- C. Piping Applications: Include watertight joints.
 - 1. NPS 3 (DN 80): Hub-and-spigot, Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. NPS 4 to NPS 6 (DN 100 to DN 150): Hub-and-spigot, Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
- D. Sleeve-Type Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.
- E. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.
- F. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.
- G. Extend sanitary sewerage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.
- H. Pipe Joint Construction and Installation: Join and install pipe and fittings according to installations indicated.

1. Hub-and-Spigot, Cast-Iron Soil Pipe and Fittings: With rubber gaskets according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook." Use gaskets that match class of pipe and fittings.
 - I. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.
 - J. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - K. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - L. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
 - M. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
 1. Place plug in end of incomplete piping at end of day and when work stops.
 2. Flush piping between manholes and other structures to remove collected debris, if required by authorized government representative.

END OF SECTION 02530

SECTION 02920

LAWNS AND GRASSES

1.1 GENERAL

- A. Submittals: In addition to Product Data for each type of product indicated, submit a planting schedule indicating anticipated planting date.
- B. Lawn Maintenance: Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Seeded Lawns: 60 days from date of Substantial Completion.
 - 2. Mow lawn as soon as top growth is tall enough to cut. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings.

1.2 PRODUCTS

- A. Seed Species: Tall Fescue.
- B. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.
 - 1. Topsoil Source: Reuse surface soil stockpiled on-site and supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Verify suitability of stockpiled surface soil to produce topsoil.
- C. Fertilizer:
 - 1. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in composition suitable for site conditions.
- D. Mulches:
 - 1. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

1.3 EXECUTION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off the Government's property.
 - 1. Apply fertilizer (if needed) directly to subgrade before loosening.

- B. **Unchanged Subgrades:** If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare surface soil as follows:
 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 2. Loosen surface soil to a depth of at least of 6 inches. Apply fertilizer and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
 3. Remove stones larger than 2 inches in any dimension and sticks, roots, trash, and other extraneous matter.
 4. Legally dispose of waste material, including grass, vegetation, and turf, off the Government's property.
- C. **Finish Grading:** Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1 inch of finish elevation.
- D. **Moisten prepared lawn areas before planting if soil is dry.** Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- E. **Restore areas if eroded or otherwise disturbed after finish grading and before planting.**
- F. **Seeding Schedule:**

	<u>Rate</u>	<u>Seeding Dates</u>	
Tall Fescue	100 lb/acre	Fall – Best	Aug. 25 – Sept. 15
		Fall – Possible	Aug. 20 – Oct. 15
		Late Winter	Feb. 15 – Mar. 21

Soil Amendments

Apply lime (ground agricultural lime-stone) 4,000 lb/acre

10-10-10 Fertilizer 1,000 lb/acre

1. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.
 2. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.
 3. Protect seeded areas from hot, dry weather or drying winds within 24 hours after completing seeding operations. Soak and scatter uniformly to a depth of 3/16 inch and roll to a smooth surface.
- G. **Satisfactory Seeded Lawn:** At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
 - H. **Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.**

END OF SECTION 02920

SECTION 03300

CAST-IN-PLACE CONCRETE

1.1 GENERAL

- A. Submittals: In addition to Product Data, submit design mixes and the following for each concrete mix:
 - 1. Shop Drawings detailing fabrication, bending, and placement.
 - 2. Material certificates signed by product manufacturers certifying that product complies with requirements.
 - 3. Test results shall be reported in writing.
- B. Quality Assurance: Comply with ACI 301, "Specification for Structural Concrete," and ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 1. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1.2 PRODUCTS

- A. Steel Reinforcement: As follows:
 - 1. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Synthetic Fiber:
 - 1. Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, ½ to 1-1/2 inches long. Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.
- C. Concrete Materials: As follows:
 - 1. Portland Cement: ASTM C 150, Type I.
 - 2. Aggregate: ASTM C 33, uniformly graded, from a single source throughout the project.
 - 3. Water: ASTM C 94, shall be clean, fresh, free from oil, organic matter, or other deleterious substances.
 - 4. Air-Entraining Admixture: ASTM C 260, Products shall be (or approved equal):
 - a. Air-Mix or AEA 92 by the Euclid Chemical Company.
 - b. MB-VR by Master Builders.
 - c. Darex Series or Daravair Series by W.R. Grace & Co.
 - 5. Water-Reducing Admixture: ASTM C 494, Type A. Shall not contain more chloride ions than are present in municipal drinking water. Products shall be (or approved equal):

- a. Eucon WR-75 by The Euclid Chemical Company.
 - b. Pozzolith 200N by Master Builders.
 - c. WRDA Series by W.R. Grace & Co.
6. High-Range, Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F. Shall not contain more chloride ions than are present in municipal drinking water. Products shall be (or approved equal):
 - a. Eucon 37 by The Euclid Chemical Company.
 - b. Rheobuild 1000 by Master Builders.
 - c. ADVA Series or Davacon Series by W.R. Grace & Co.
 7. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E. Shall not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Products shall be (or approved equal):
 - a. Accelguard 80 by The Euclid Chemical Company.
 - b. Polarset or Lubricon NCA by W. R. Grace Company.
 8. Water-Reducing and Retarding Admixture: ASTM C 494, Type D. Water Reducing, Retarding Admixture: Shall not contain more chloride ions than are present in municipal drinking water. Products shall be (or approved equal):
 - a. Eucon Retarder-75 by The Euclid Chemical Company.
 - b. Possolith 100XR by Master Builders.
 - c. Daratard-17 by W.R. Grace & Co.
 9. Fly Ash: ASTM C 618, Type F. Fly ash shall be obtained from one source for the concrete delivered to the project and not exceed 20 percent of the total cementitious material.

D. Related Materials: As follows:

1. Vapor Retarder: Polyethylene sheet, ASTM D 4397, thickness on Drawings.
2. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
3. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
4. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, of type, class, and grade to suit requirements.

E. Curing Materials: As follows:

1. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
2. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
3. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
4. Clear, Solvent-Borne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
5. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
6. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

7. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- F. Concrete Mixes: Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, with the following properties:
1. Compressive Strength (28 Days): 3,000 psi or as indicated on Drawings.
 2. Slump: 3 to 4 inches.
 3. Air Content: 4.5 to 7.0 percent for all exterior concrete subject to freezing and thawing.
- G. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
- H. Non-shrink Grout:
1. The non-shrink grout shall be:
 - a. Euco NS by The Euclid Chemical Company.
 - b. Five Star Grout by the U.S. Grout Corporation.
 The factory pre-mixed grout shall conform to ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 4' x 4' base plate.
 2. The high flow grout shall be used where high fluidity and/or increase placing time is required. Products shall be:
 - a. Euco Hi-Flow Grout by The Euclid Chemical Company.
 - b. Masterflow 928 by Master Builders.
 The factory pre-mixed grout shall conform to ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 18" x 36" base plate.

1.3 EXECUTION

- A. Design, construct, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- C. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved 28-day design compressive strength.
- D. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

- E. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643.
- F. Steel Reinforcement: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- G. Joints: Locate and install construction, isolation, and contraction joints.
- H. Concrete Placement: Deposit concrete continuously and avoid segregation. Deposit concrete in forms in horizontal layers no deeper than 24 inches, avoiding cold joints.
 - 1. Consolidate concrete with mechanical vibrating equipment.
 - 2. Screed and initial-float concrete floors and slabs using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
 - 3. Comply with ACI 306.1 for cold-weather concrete placement.
 - 4. Place concrete according to recommendations in ACI 305R when hot-weather conditions exist.
- I. Finish formed surfaces as follows:
 - 1. Apply rough-formed finish, defined in ACI 301, to concrete surfaces indicated or not exposed to public view.
 - 2. Apply smooth-formed finish, defined in ACI 301, to concrete surfaces indicated and exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
 - 3. Apply smooth-rubbed finish to smooth-formed finished concrete surfaces indicated or exposed to public view.
- J. Finishing Floors and Slabs: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Finish unformed surfaces as follows:
 - 1. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing.
 - 2. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.
 - 3. Nonslip Broom Finish: Apply a nonslip broom finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

- K. Concrete Protection and Curing: Protect concrete from excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
1. Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause excessive moisture loss.
 2. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
 3. Cure formed and unformed concrete for at least seven days by moisture curing, moisture-retaining-cover curing, or curing compound.
 4. Cure and seal floors and slabs with a curing and sealing compound according to manufacturer's written instructions.
- L. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement.
- M. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 6. Compression Test Specimens: ASTM C 31 cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.
 - a. Test two field-cured specimens at 7 days and two at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- N. Defective Concrete: Repair and patch defective areas when approved. Remove and replace concrete that cannot be repaired and patched.

END OF SECTION 03300

SECTION 04810

UNIT MASONRY ASSEMBLIES

1.1 GENERAL

- A. Submittals: In addition to Product Data, submit the following:
 - 1. Samples showing the full range of colors and textures available for exposed masonry units.
 - 2. Material Certificates: For each type of masonry unit required.
- B. Cold-Weather Requirements: Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- C. Hot-Weather Requirements: When ambient temperature exceeds 100 deg F (38 deg C), or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar.

1.2 PRODUCTS

- A. Decorative Concrete Masonry Units: ASTM C 90 and as follows:
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
 - 2. Weight Classification: Normal weight.
 - 3. Provide Type II, nonmoisture-controlled units.
 - 4. Finish: Exposed faces of the following general description; color to be selected by Contracting Officer or authorized representative:
 - a. Normal weight aggregate, split-face finish.
 - 5. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
- B. Mortar and Grout Materials: As follows:
 - 1. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
 - 2. Hydrated Lime: ASTM C 207, Type S.
 - 3. Mortar Cement: ASTM C 1329.
 - 4. Masonry Cement: ASTM C 91.
 - 5. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

- a. Colored-Mortar Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.
 - 6. Aggregate for Grout: ASTM C 404.
 - 7. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units.
 - 8. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.
 - 9. Water: Potable.
- C. Steel Reinforcing Bars: ASTM A 615, Grade 60.
- D. Masonry Joint Reinforcement: ASTM A 951; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.
- 1. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
 - 2. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
 - 3. For single-wythe masonry, provide either ladder or truss type with single pair of side rods and cross rods spaced not more than 16 inches o.c.
- E. Concealed Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:
- 1. Copper-Laminated Flashing: Manufacturer's standard laminated flashing consisting of 5-oz./sq. ft. sheet copper bonded with asphalt between 2 layers of glass-fiber cloth.
 - 2. Rubberized-Asphalt Flashing: Manufacturer's standard composite flashing product consisting of a pliable and highly adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of 0.030 inch.
 - 3. Elastomeric Thermoplastic Flashing: Manufacturer's standard composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy 0.025 inch thick with a 0.015-inch-thick layer of rubberized-asphalt adhesive.
 - 4. EPDM Flashing: Manufacturer's standard flashing product formed from a terpolymer of ethylene-propylene diene, complying with ASTM D 4637, 0.040 inch thick.
- F. Miscellaneous Masonry Accessories: As follows:
- 1. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene, urethane or PVC.
 - 2. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- G. Loose-Granular Fill Insulation: Perlite complying with ASTM C 549, Type II or IV.

- H. Masonry Cleaners: As follows:
1. Job-Mixed Detergent Solution: Solution of 1/2-cup dry measure tetrasodium polyphosphate and 1/2-cup dry measure laundry detergent dissolved in 1 gal. of water.
- I. Mortar and Grout Mixes: Do not use admixtures, unless otherwise indicated. Do not use calcium chloride in mortar or grout.
1. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification.
 - a. Extended-Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above, at Contractor's option.
 - b. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
 - c. For masonry below grade, in contact with earth, and where indicated, use Type S.
 - d. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 2. Grout for Unit Masonry: Comply with ASTM C 476.
 - a. Use grout of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - b. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.
- J. Source Quality Control: Contractor will engage a qualified independent testing agency to perform source quality-control testing indicated below. Payment for these services will be made by the Government.
1. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

1.3 EXECUTION

- A. Cut masonry units with motor-driven saws. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
- C. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.
 2. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.
- D. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- E. Bond Pattern for Exposed Masonry: Lay exposed masonry in bond pattern indicated; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- F. 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.
- G. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- H. Lay hollow masonry units as follows:
1. With full mortar coverage on horizontal and vertical face shells.
 2. 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.
 3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
- I. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.
- J. Provide continuous masonry joint reinforcement as indicated. Install with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
1. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections.
- K. Provide masonry lintels where shown. Provide precast lintels made from concrete matching concrete masonry units in color, texture, and compressive strength and with reinforcing bars indicated or required to support loads indicated.
- L. Embedded Flashing: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- M. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.

1. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- N. Placing Reinforcement: Comply with requirements of ACI 530.1/ASCE 6/TMS 602.
- O. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
- P. Cleaning: Clean unit masonry as follows:
1. By dry brushing to remove mortar fins and smears before tooling joints, as work progresses.
 2. After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - a. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 - b. Protect adjacent surfaces from contact with cleaner.
 - c. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
 - d. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.
- Q. Masonry Waste Disposal: Dispose of clean masonry waste, including broken masonry units, waste mortar, and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
 2. Remove excess, clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off the Government's property.

END OF SECTION 04810

SECTION 05210

STEEL JOISTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Open-web, K-series steel joists.

1.2 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product indicated.
- B. Shop Drawings: Showing layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.
 - 1. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.
- B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for chord and web members.

- B. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers; plain, uncoated.
- C. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers; plain, uncoated.

2.2 PRIMERS

- A. Primer: SSPC-Paint 15, Type I, red oxide; FS TT-P-636, red oxide; or manufacturer's standard shop primer complying with performance requirements of either of these red-oxide primers.

2.3 STEEL JOISTS

- A. Manufacture steel joists according to SJI's "Specifications," with steel-angle top- and bottom-chord members, and as follows:
 - 1. Manufacture steel joists according to "Standard Specifications for Open Web Steel Joists, K-Series," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.
- B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications."
- C. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.5 SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Apply 1 shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
- C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts, unless otherwise indicated.
- E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

END OF SECTION 05210

SECTION 05310

STEEL DECK

1.1 GENERAL

- A. Submittals: In addition to Product Data for each type of deck and accessory, submit the following:
 - 1. Shop Drawings showing layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.
 - 2. Product certificates signed by steel deck manufacturers certifying that products furnished comply with requirements.
- B. Quality Assurance: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" for calculating structural characteristics of steel deck.
 - 1. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.2 PRODUCTS

- A. Steel Roof Deck: Fabricate panels to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 29, and the following:
 - 1. Galvanized Steel Sheet: ASTM A 653.
 - 2. Deck Profile: Type NR, narrow rib.
 - 3. Profile Depth: 1-1/2 inches.
 - 4. Design Uncoated-Steel Thickness: 0.0295 inch.
- B. Accessories: Steel deck manufacturer's standard accessory materials, including mechanical fasteners, closure strips, pour stops, and closures for deck.

1.3 EXECUTION

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.
 - 1. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 2. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
 - 3. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking.

4. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.
 5. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- B. Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

END OF SECTION 05310

SECTION 06105

MISCELLANEOUS CARPENTRY

1.1 GENERAL

A. Submittals:

1. Product Data: For wood-preservative and fire-retardant treatment from chemical treatment manufacturers and certification by treating plants that treated materials comply with requirements.
2. Certificate of Compliance:
 - a. Wood Structural Panels (Plywood): Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.

1.2 PRODUCTS

A. Lumber, General: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review. Factory mark each piece of lumber with grade stamp of grading agency.

1. For exposed lumber, mark grade stamp on end or back of each piece.
2. Provide dressed lumber, S4S, unless otherwise indicated.
3. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

B. Wood Structural Panels, General:

1. Plywood: DOC PS 1 or DOC PS 2, unless otherwise indicated.

C. Wood-Preservative-Treated Materials: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
2. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
3. Application: Treat items indicated on Drawings, and the following:
 - a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

- b. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

- D. Fire-Retardant-Treated Materials: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Use Exterior type for exterior locations and where indicated.
 - 2. Use Interior Type A High Temperature (HT), unless otherwise indicated.

- E. Provide miscellaneous lumber for support or attachment of other construction.
 - 1. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content of any species.
 - 2. For exposed boards, provide lumber, with 15 percent maximum moisture content, of eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Finish or 1 Common (Colonial) grade; NELMA, NLGA, WCLIB, or WWPA.
 - 3. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 - a. Mixed southern pine, No. 2 grade; SPIB.
 - b. Eastern softwoods, No. 2 Common grade; NELMA.
 - c. Northern species, No. 2 Common grade; NLGA.
 - d. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

- F. Miscellaneous Concealed Plywood: Exterior sheathing, span rating to suit framing in each location, and thickness as indicated but not less than 1/2 inch (13 mm).

- G. Miscellaneous Exposed Plywood: DOC PS 1, A-D Interior, thickness as indicated but not less than 1/2 inch (13 mm).

- H. Fasteners: Provide fasteners of size and type indicated.
 - 1. Where carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 - 2. Power-Driven Fasteners: CABO NER-272.
 - 3. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings.

1.3 EXECUTION

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

- B. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
- C. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.
- D. Wood Trim Installation: Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Cope at returns and miter at corners to produce tight-fitting joints. Use scarf joints for end-to-end joints.
 - 1. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.6-mm) maximum offset for reveal installation.

END OF SECTION 06105

SECTION 07610

STANDING SEAM METAL ROOFING

PART 1 - GENERAL

A. System Description:

1. Design and Performance Criteria:
 - a. Thermal Movement: Completed metal roofing and flashing system capable of withstanding expansion and contraction of components caused by temperature range from -10° F to +120 ° F without buckling, producing excess stress on structure, anchors or fasteners, or reducing performance ability.
2. Uniform Wind Load Capacity:
 - a. Capacity determined in compliance with AA publication "Specification for Aluminum Structures", 1986 Edition, and principles of ASTM E330, Procedure A, adapted to testing roof panels as follows:
 - (7.1) Roof test specimens either full length or representative of main body of roof, free from edge restraint of perimeter attachments, continuous over one or more supports, and containing at least five panel modules for standing seam roof.
 - (7.2) No attachments are permitted at sides or end perimeter other than those that occur uniformly throughout roof. Side and end seals shall be flexible and in no way restrain crosswise distortion of panels.
 - (7.2.1) Panels and accessories production materials of same type and thickness proposed for use on Project.
 - (10.1.1) Seals or film shall not span any crevices or cracks that may tend to separate under pressure.
 - b. Installed roof system shall withstand positive or negative design wind loading pressures complying with 1994 Uniform Building Code with 1997 Revisions and 1994 North Carolina State Building Code with 1999 Revisions, with maximum system deflection of L/140 and maximum panel deflection of 0.04% and in compliance with ASCE 7-93, UL 90 and ASTM E1592.
3. Concentrated Load Capacity: Withstand load of 250 lbs. applied to four-inch by four-inch square area located in center of panel between stiffener ribs without buckling of ribs or permanent panel distortion.

4. Water Penetration (Dynamic Pressure): No uncontrolled water penetration, other than condensation, when tested in compliance with ASTM E1646 at minimum differential pressure of 20 percent of inward acting, wind load design pressure of 6.24 psf and not more than 12 psf.
5. Air Infiltration: Provide preformed roof panel assemblies with permanent resistance to air leakage through assembly of not more than 0.09 cfm/sq. ft of fixed roof area when tested according to ASTM E1680 at static air pressure difference of 4.0 lbf/sq. ft.
6. Capacities for gauge, span or loading other than those tested may be determined by interpolation of test results within range of test data. Extrapolation for conditions outside test range is not acceptable.

1.2 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
 1. A792-93a Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, General Requirements.
 2. D1056-91 Flexible Cellular Materials – Sponge or Expanded Rubber.
 3. E1592-94 Test Method for Structural Performance of Sheet Metal Roofing and Siding Systems by Uniform Air Pressure Difference.
 4. E1646-95 Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
 5. E1680-95 Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems.
- B. Architectural Aluminum Manufacturers Association (AAMA):
 1. 501-83 Methods of Test for Metal Curtain Walls.
 2. 605.2-92 Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
- C. American Society of Civil Engineers (ASCE):
 1. 7-95 Minimum Design Loads for Buildings and Other Structures.
- D. National Roofing Contractors Association (NRCA):
 1. The NRCA Construction Details – Third Edition.
- E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):
 1. Architectural Sheet Metal Manual, Fifth Edition, 1993.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's detailed material and system description, installation instructions, and engineering performance data and finish specifications.

- B. Shop Drawings: Show roofing system with flashings and accessories in plan and elevation; sections and all details at full scale. Include metal thicknesses and finishes, panel lengths, joining details, anchorage details, flashings and special fabrication provisions for termination and penetrations; girt locations expansion provisions and special supports. Indicate relationships with adjacent and interfacing work.
- C. Samples:
 - 1. Panel section, minimum 2'-0" in length by full width, indicating thickness, profile, texture and color.
 - 2. Submit samples of panel clips, closures, insulation and accessory items.
- D. Design Calculations: Submit design calculations, indicating compliance with specified performance criteria. Design calculations shall bear seal of registered engineer licensed to practice in the State of North Carolina. Indicate that engineer has reviewed shop drawings.
- E. Test Reports:
 - 1. Submit reports by independent testing laboratory to support structural calculations and show compliance with specified performance criteria.
 - 2. Tests shall have been made for substantially identical systems within ranges of specified performance criteria.
 - 3. If test data is not available, or if data does not represent project conditions, Contractor shall be responsible for securing satisfactory tests by independent testing agency acceptable to Contracting Officer or authorized representative, with all costs of such testing borne by Contractor.

1.4 QUALITY ASSURANCE

- A. Fabricator/Installer Qualifications:
 - 1. Installer trained and approved by system manufacturer, with trained supervisory personnel observing and directing work.
 - 2. If required, proposed fabricator/installer shall submit work and proof of adequate financial responsibility. Contracting Officer or authorized representative reserves the right to inspect fabrication facilities in determining qualifications.
- B. Fire-Test-Response Characteristics: Where fire-resistance-rated roof panel 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.
- C. Preinstallation Conference; Prior to beginning metal roofing work, prerooting conference will be held to review work to be accomplished.
 - 1. Contractor, Contracting Officer or authorized representative, metal roofing subcontractor, metal roofing system manufacturer's representative and all other subcontractors who have equipment penetrating roof or whose work involves access to roof shall be present.
 - 2. Contractor shall notify Contracting Officer or authorized representative and other attending parties' minimum three days prior to time for conference.

3. Contractor shall record minutes of meeting and shall distribute copies of minutes to attending parties.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect components during fabrication, shipment, storage, handling, and erection from mechanical abuse, stains, discoloration, and corrosion.
- B. Maintain strippable plastic protective film on finished surfaces until panel is erected.
- C. Store materials off ground, adequately shored, and under cover and protected from wind movement, foreign material contamination, mechanical damage, cement, lime, or other corrosive substances.
- D. Handle materials to prevent damage to surfaces, edges and ends of roofing sheets and sheet metal items. Damaged material shall be rejected and removed from site.
- E. Protect panels from wind related damages during erection.
- F. Inspect materials upon delivery. Reject and remove from site physically damaged or marred material.

1.6 WARRANTY

- A. Endorse and Forward to Government Following Warranties:
 1. Manufacturer's twenty-year warranty covering replacement of defective materials, structural defects and corrosion.
 2. Applicator's five year finish warranty covering refinishing of fluoropolymer coating due to checking, crazing, peeling, chalking or fading.
 3. Installer's five-year warranty covering roofing system installation and watertightness.
 4. All warranties shall commence on Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer and Type: Berridge Manufacturers (or approved equal) "Zee-Lock", double-seamed, prefinished 24 "galvalume" standing seam metal roofing system in color to match Petersen's Aluminum "Dark Bronze".
- B. Other Acceptable Manufacturers (or approved equal):
 1. Berridge Manufacturing Co.
 2. Carlisle Engineered Metals
 3. Merchant & Evans, Inc.
 4. Smith-Steelite, Inc.
 5. Zip-Rib, Inc.

2.2 METAL ROOFING SYSTEM

A. Materials:

1. Panel Material: ASTM A792, 24 gauge, prefinished "Galvalume" sheet comprised of 55% aluminum, 1.6% silicon and the balance zinc.
2. Flashing and Flat Stock Material: 24 gauge thickness galvalume of same type and finish as panels.
3. Finish on Exposed Surfaces: Two coat shop-applied, baked on fluoropolymer coating system based on Elf Arochem "Kynar 500" resin or Ausimont "Hylar 5000" resin (Polyvinylidene fluoride, PVDF), formulated by licensed manufacturer and applied by manufacturer's approved applicator to meet AAMA Publication 605.2.
 - a. Coating System: Minimum 1.3 mil dry film thickness consisting of 0.3 (+ 0.1) mil primer, minimum 1.0 mil color coat. Both color coat and clear top coat containing minimum 70% polyvinylidene fluoride resin by weight; complying with AAMA 1402, Test Method No. 7.
 - b. Color: Standard to match Petersen Aluminum "Dark Bronze".
4. Finish on Unexposed Interior Face: Neutral wash coat.
5. Protective Surfacing: Provide strippable plastic film covering on finish surfaces to prevent abrasion during fabrication, storage and handling.

B. Characteristics:

1. Configuration: Standing seams incorporating mechanically seamed sidelap, concealed anchor clips allowing thermal movement, and of configuration which will prevent entrance or passage of water.
2. Seam Height: 2 inch minimum.
3. Panel Width: 16" o.c. between standing seams.
4. Panel Surface: Smooth.
5. Stiffener Ribs: 3/8-inch maximum, spaced 4-inches to 6-inches o.c., parallel to seams.
6. Panel Length: Full length without joints, including bends, where applicable.

C. Accessories:

1. Anchor Clips: 18 gauge domestic galvanized steel, 33 ksi yield strength, double strength, double fastener with UL imprint, designed to receive recessed mechanical anchor into decking or structural support elements, girts or blocking. Clips shall allow free thermal expansion and contraction movement, relative to structure, within full temperature ranges specified.
2. Anchors: Noncorrosive cadmium plated hardened self-drilling hexagonal head steel screws designed to meet structural loading requirements.
3. Exposed Fasteners: Stainless steel self-tapping hexagonal head screws with neoprene sealing washers. #14 size minimum, head finished to match panel color.
4. Closures: Factory pre-cut closed cell foam complying with ASTM D1056, Grade SCE-41 (EPT), and field fabricated PVC hip closures, enclosed in metal channel matching panels when used at hip and ridge.
5. Provide all miscellaneous accessories for complete installation. All accessories shall be furnished by roofing system manufacturer.
6. Building Felt: ASTM D226, Type II, No. 30, asphalt-saturated organic felts.

7. Waterproof Underlayment: Cold-applied, self adhering membrane composed of high strength polyethylene film coated on one side with thick layer of adhesive-consistency rubberized asphalt, fully adhered, 40 mils thick; self-healing.
 - a. Protecto Wrap Co. "Jiffy Seal" (or approved equal).
 - b. Nord Bitumi US, Inc. "Nordshield Ice and Water Guard" (or approved equal).
 - c. W. R. Grace & Co. "Bituthene Ice and Water Shield" (or approved equal).
 - d. Polyguard Products, Inc. "Polyguard Deck Guard" (or approved equal).
8. Roof Insulation Board: Unfaced, Flexible Glass-Fiber Board Insulation: ASTM C 612, TYPE IA; ASTM C 553, Types I, II, and III; or ASTM C 665, Type I; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; and of the following properties:
 - a. Nominal density of 1.0 lb/cu. Ft. (16 kg/cu. M), thermal resistivity of 3.7 deg F x h x sq. ft./Btu x in. at 75 deg F (25.7 K x m/W at 24 deg C).
 - b. Combustion Characteristics: Passes ASTM E 136.
9. Gypsum Board: As specified in 09260: "Gypsum Board Assemblies".

2.3 FABRICATION

- A. Prefabricate metal roof panels and flashing components to maximum extent possible, forming metal work with clear, sharp, straight and uniform bends and arrises. Hem exposed edges of flashings.
- B. Form flashing components from full single width sheet. Provide shop fabricated, mitered corners, joined using closed end pop rivets and joint sealant.
- C. Fabricate roofing and related sheet metal work in compliance with approved shop drawings and applicable standards. Form sheet metal work with clear, sharp, and uniform arrises. Hem exposed edges.
- D. Make joints in aluminum sheets using flat-lock seams, 3/4-inch in width. Fill seams with exterior sealant.
- E. Provide linear sheet metal items in minimum 10'-0" sections except as otherwise noted. Form flashing using single pieces for full width. Provide shop fabricated, mitered joints and corners, with minimum 2'-0" long legs.
- F. Clips:
 1. Provide UL listed clip designed to allow panels to thermally expand and contract.
 2. Fabricate clips with embossings that raise underside of panels above substrate to create positive ventilation and eliminate underside-condensation and corrosion.
 3. Fabricate clips with structurally embossed outstanding legs to prevent distortion due to wind uplift forces.

PART 3 - EXECUTION

3.1 DECK PREPARATION

- A. Install roof board insulation to metal deck with approved noncorrosive mechanical fasteners spaced to meet wind uplift criteria.
- B. Apply one layer of 30# felt over deck substrates with horizontal overlaps and end laps staggered between layers.
 - 1. Lay felt parallel to ridge line with 2-1/2-inch horizontal laps and 6-inch vertical laps.
- C. On valleys and ridges and areas where ice and water may stand, install one layer of waterproof underlayment in compliance with manufacturer's printed instructions.
- D. Omit felt underlayment at areas of waterproof underlayment. Lap felt underlayment over waterproof underlayment as recommended by manufacturer, but not less than 2-inches.

3.2 ROOFING AND FLASHING INSTALLATION

- A. Inspection: Examine alignment and placement of building structure before proceeding with installation of preformed standing seam metal roofing.
- B. Install roofing and flashings in compliance with approved shop drawings and within specified erection tolerances.
- C. Isolate dissimilar metals and masonry or concrete from metals with bituminous paint, tape, or flexible flashing specified in Section 07600. Use gasketed fasteners where required to prevent corrosive action between fastener, substrate and panels.
- D. Use exposed fasteners, prefinished to match finish of panels and trim. Limit exposed fasteners to extent indicated on shop drawings.
- E. Anchorage shall allow for temperature expansion/contraction movement within specified range without stress or elongation of panels, clips or anchors. Attach clips to purlins, sleepers or track using self-drilling screws of size and spacing as determined by manufacturer's design analysis to resist specified uplift and thermal movement forces.
- F. Seal laps and joints in compliance with roofing system manufacturer's product data.
- G. Coordinate flashing and sheet metal work to provide weathertight conditions at roof terminations. Fabricate and install in compliance with standards of SMACNA "Architectural Sheet Metal Manual" and NRCA "Construction Details" using continuous cleats at all exposed edges.

- H. Provide for temperature expansion/contraction movement of panels at roof penetrations and roof mounted equipment as recommended by system manufacturer.
- I. Installed system shall be true to line and plane and free of dents, oilcans and physical defects.
- J. Form joints in linear sheet metal to allow for ½-inch minimum expansion at 12'-0" o.c. maximum and 2'-0" from corners. Provide 1'-0" wide back-up plate at intersections. Form plates to profile of sheet metal item.
- K. At joints in linear sheet metal items, set sheet metal over back-up plate in two beads of butyl sealant, ¼-inch in diameter, minimum. Extend sealant over all metal surfaces. Accurately mate components for positive seal. Allow no sealant to migrate onto exposed surfaces.
- L. Remove damaged work and replace with new, undamaged components.
- M. Applicable Erection Tolerances: Maximum variation from true planes and lines: ¼-inch in 20'-0", 3/8-inch in 40'-0" or more.

3.3 CLEANING

- A. Remove protective film and clean exposed surfaces of preformed roofing and accessories after completion of installation. Leave in clean condition at Date of Substantial Completion. Touch up minor abrasions and scratches in finish to satisfaction of Contracting Officer or authorized representative.

END OF SECTION 07610

SECTION 07841

THROUGH-PENETRATION FIRESTOP SYSTEMS

1.1 GENERAL

- A. Performance Requirements: Provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - a. Penetrations located outside wall cavities.
 - b. Penetrations located outside fire-resistive shaft enclosures.
 - c. Penetrations located in construction containing fire-protection-rated openings.
 - d. Penetrating items larger than 4-inch- (100-mm-) diameter nominal pipe or 16 sq. in. (100 sq. cm) in overall cross-sectional area.
 3. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
 - a. For piping penetrations for wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - b. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
 4. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.
- B. Submittals: In addition to Product Data for each type of product specified, submit the following:
1. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction.

2. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.
 3. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.
- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Paragraph:
1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 2. Through-penetration firestop systems are identical to those tested per ASTM E 814 and bear classification marking of qualified testing and inspecting agency.

1.2 PRODUCTS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following (or approved equal):
1. DAP Inc.
 2. Firestop Systems Inc.
 3. Hilti Construction Chemicals, Inc.
 4. RectorSeal Corporation (The).
 5. 3M Fire Protection Products.
 6. Tremco.
 7. United States Gypsum Company.
- C. Firestopping, General: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- D. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Paragraph. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
1. Permanent forming/damming/backing materials.
 2. Temporary forming materials.
 3. Substrate primers.

4. Collars.
 5. Steel sleeves.
- E. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of this Section by reference to the types of materials described below. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
1. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
 2. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
 3. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
 4. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
 5. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
 6. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
 7. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
 8. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants.

1.3 EXECUTION

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Paragraph and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Through-penetration firestop system designation of applicable testing and inspecting agency.

4. Date of installation.
 5. Through-penetration firestop system manufacturer's name.
 6. Installer's name.
- D. Through-Penetration Firestop System Schedule: Where UL-classified systems are indicated, they refer to the alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.
1. Firestop Systems for Metallic Pipes, Conduit, or Tubing FS-<#>: Comply with the following:
 - a. UL-Classified Systems: [C-AJ-] [C-BJ-] [C-BK-] [F-A-] [F-B-] [F-C-] [W-J-] [W-K-] [W-L-] <Insert one or more four-digit numbers> [1001-1999].

END OF SECTION 07841

SECTION 07920

JOINT SEALANTS

1.1 GENERAL

- A. Preconstruction Joint-Sealant-Substrate Tests: Submit substrate materials, representative of actual joint surfaces, to joint sealant manufacturer for laboratory testing of joint sealants for adhesion to primed and unprimed substrates and for compatibility with joint substrates and other joint-related materials.
- B. Submittals: In addition to Product Data, submit the following:
 - 1. Samples of each type and color of joint sealant required.
 - 2. Test reports for joint sealants evidencing compliance with requirements.

1.2 PRODUCTS

- A. Elastomeric Sealant Manufacturers: Subject to compliance with requirements, provide sealants by one of the following (or approved equal):
 - 1. Silicone Sealants:
 - a. Dow Corning.
 - b. GE Silicones.
 - c. NUCO Industries, Inc.
 - d. Sonneborn Building Products Div., ChemRex Inc.
 - e. Tremco.
 - 2. Urethane Sealants:
 - a. Polymeric Systems, Inc.
 - b. Sonneborn Building Products Div., ChemRex Inc.
 - c. Tremco.
- B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by testing and field experience.
- C. Colors: Provide colors indicated for exposed joint sealants or, if not indicated, as selected by Contracting Officer's Representative from manufacturer's full range for this characteristic.
- D. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant of base polymer specified below:

1. Low-Modulus Neutral-Curing Silicone Sealant: Type S, Grade NS, Class 25, and as follows:
 - a. Uses NT, G, A, and O.
 - b. Additional capability, when tested per ASTM C 719, to withstand the following percentage changes in joint width and still comply with other requirements of ASTM C 920:
 - 1) 100 percent movement in extension and 50 percent movement in compression for a total of 150 percent movement.
 - c. Applications: Window and door frames, thresholds and lintels.
2. High-Modulus Neutral-Curing Silicone Sealant: Type S; Grade NS; Class 25; and as follows:
 - a. Uses NT, M, G, A, and O.
 - b. Applications: Galvanized steel and miscellaneous aluminum flashing.
3. Mildew-Resistant Silicone Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and O; formulated with fungicide; intended for sealing interior joints with nonporous substrates exposed to high humidity and temperature extremes.
4. Single-Component Nonsag Urethane Sealant: Type S; Grade NS; and as follows:
 - a. Class 25.
 - b. Uses NT, M, A, and O.
 - c. Applications: Exterior masonry joints.
- E. Latex Sealant: ASTM C 834.
- F. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834.
- G. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
- H. Sealant Backings, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- I. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 1. Type O: Open-cell material.

- J. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C).
- K. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint.
- L. Primer: As recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

1.3 EXECUTION

- A. General: Comply with joint sealant manufacturer's instructions for products and applications indicated.
- B. Sealant Installation Standard: Comply with ASTM C 1193.
- C. Acoustical Sealant Application Standard: Comply with ASTM C 919 for use of joint sealants in acoustical applications.

END OF SECTION 07920

SECTION 08110

STEEL DOORS AND FRAMES

1.1 GENERAL

A. Submittals:

1. Product Data and Shop Drawings for each type of door and frame indicated.
2. Door Schedule using same reference designations indicated on Drawings in preparing schedule for doors and frames.

B. Quality Assurance:

1. Comply with ANSI A 250.8, unless more stringent requirements are indicated.

1.2 PRODUCTS

A. Materials:

1. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
2. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.
3. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with A40 (ZF120) zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.
4. Electrolytic Zinc-Coated Steel Sheets: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized; suitable for unexposed applications; stretcher-leveled standard of flatness where used for face sheets.

B. Interior Doors: Complying with ANSI 250.8 for level and model and ANSI A250.4 for physical-endurance level indicated.

1. Level 2 and Physical Performance Level B, Model 1 (Full Flush)

C. Exterior Doors: Doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 3 and Physical Performance Level A, Model 1 (Full Flush).

D. Frames: Provide steel frames that comply with ANSI A250.8 and with steel sheet thickness as indicated for door level selected below:

1. For Level 2 steel doors, 0.053 inch (1.3 mm).
2. For Level 3 steel doors, 0.067 inch (1.7 mm).

3. Door Silencers: Three silencers on single-door frames and two silencers on double-door frames.
 4. Supports and Anchors: Not less than 0.042-inch- (1.0-mm-) thick, zinc-coated steel sheet.
 5. Wall Anchors in Masonry Construction: 0.177-inch- (4.5-mm-) diameter, steel wire complying with ASTM A 510 (ASTM A 510M) may be used in place of steel sheet.
 6. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.
- E. Fabricate steel door and frame units to comply with ANSI A250.8 and to be free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant.
1. Doors and Frames: Fabricate from metallic-coated steel sheet. Close top and bottom edges of doors flush.
 2. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards.
 3. Tolerances: Comply with SDI 117.
 4. Prepare doors and frames to receive hardware. Reinforce doors and frames to receive surface-applied hardware. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
 5. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints. Provide temporary spreader bars.
 6. Provide nonremovable glazing stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
 7. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.
- F. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

1.3 EXECUTION

- A. Install doors and frames according to Shop Drawings and manufacturer's data.
1. Frames: Install steel frames for doors and other openings, of size and profile indicated.
 - a. Provide at least three wall anchors per jamb. For openings 90 inches (2286 mm) or more in height, install an additional anchor at hinge and strike jambs.
 - b. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

- 1) At existing concrete or masonry construction, set frames and secure in place with machine screws and masonry anchorage devices.
 2. Doors: Install to comply with ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
 - a. Jambs and Head: 1/8 inch (3.2 mm).
 - b. Meeting Edges, Pairs of Doors: 1/4 inch (6.4 mm).
 - c. Bottom: 3/4 inch (19 mm).
- B. Adjusting and Cleaning:
1. Prime-Coat Touchup: Sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
 2. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 08110

SECTION 08711

DOOR HARDWARE (SCHEDULED BY NAMING PRODUCTS)

1.1 GENERAL

- A. Submittals: In addition to Product Data for each item specified, submit the following:
 - 1. Door Hardware Schedule: Organize into door hardware sets indicating type, style, function, size, label, hand, manufacturer, fasteners, location, and finish of each door hardware item.
- B. Supplier Qualifications: Door hardware supplier who is or employs a qualified DHI Architectural Hardware Consultant.
- C. Templates: Obtain and distribute templates for doors, frames, and other work specified to be factory prepared for installing door hardware.

1.2 PRODUCTS

- A. Scheduled Door Hardware: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in door and frame schedule.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
 - 2. Designations: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- B. Standards: Comply with BHMA A156 series standards, Grade 1, unless Grade 2 is indicated.
- C. Certified Products: Provide door hardware that is listed in one of BHMA's directories of certified products.
- D. Hinges and Pivots: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
 - 1. Hinge Base Metal: Unless otherwise indicated, provide the following:
 - a. Exterior Hinges: Stainless steel, with stainless-steel pin.
 - b. Interior Hinges: Stainless steel, with stainless-steel pin.
 - c. Hinges for Fire-Rated Assemblies: Stainless steel, with stainless-steel pin.
 - 2. Nonremovable Pins: Provide set screw in hinge barrel that prevents removal of pin while door is closed; for outswinging exterior doors and outswinging corridor doors with locks.
 - 3. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.

4. Screws: Phillips flat-head screws. Finish screw heads to match surface of hinges.
- E. Locks and Latches: As follows:
1. Provide the lockset design designated below:
 - a. Bored Locks: Best; 9K Series, 14L (or approved equal).
 2. Dummy Trim: Match lever lock trim and escutcheons.
 3. Lock Throw: Comply with labeled fire door requirements.
 4. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.
- F. Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
1. Number of Pins: Six.
 2. High-Security Grade: BHMA Grade 1A, listed and labeled as complying with UL 437 (Suffix A).
 3. Manufacturer: Same manufacturer as for locks and latches.
 4. Permanent Cores: Manufacturer's standard; finish face to match lockset; removable cores.
 5. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
 6. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.
 - a. Replace construction cores with permanent cores, as directed by Owner.
- G. Keying System: Coordinate with Contracting Officer's Representative.
1. Keys: Provide nickel-silver keys permanently inscribed with a visual key control number and "DO NOT DUPLICATE" notation. In addition to one extra blank key for each lock, provide three change keys and five master keys.
- H. Strikes: Manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.
- I. Closers: Comply with the following:
1. Size of Units: Factory sized, adjustable to meet field conditions and requirements for opening force.
- J. Protective Trim Units: Furnish protection plates sized 1-1/2 inches (38 mm) less than door width on push side and 1/2 inch (13 mm) less than door width on pull side, by height specified in Door Hardware Schedule. Fasten with exposed machine or self-tapping screws.
- K. Floor Stops: For doors, unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

- L. Door Gasketing: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
 - 1. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
 - 2. Gasketing Materials: Comply with ASTM D 2000 and AAMA 701/702.

M. Fabrication: As follows:

- 1. Base Metals: Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials if different from specified standard.
- 2. Fasteners: Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated. Provide steel machine or wood screws or steel through bolts for fire-rated applications.
- 3. Spacers or Sex Bolts: For through bolting of hollow metal doors.
- 4. Fasteners for Wood Doors: Comply with requirements of DHI WDHS.2, "Recommended Fasteners for Wood Doors."

1.3 EXECUTION

- A. Examine doors and frames for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- B. Steel Door and Frame Preparation: Comply with DHI A115 series. Drill and tap doors and frames for surface-applied hardware according to SDI 107.
- C. Mounting Heights: Comply with DHI requirements, unless otherwise indicated.
- D. Installation: Comply with manufacturer's written instructions. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 - 1. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Adjust and check each operating item of door hardware and each door to ensure proper operation or function. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with accessibility requirements. Clean operating items as necessary to restore proper function and finish.

F. Door Hardware Schedule: as noted on Drawings:

END OF SECTION 08711

SECTION 09260

GYPSUM BOARD ASSEMBLIES

1.1 GENERAL

- A. Submittals: Product Data for each type of product indicated.

1.2 PRODUCTS

- A. Steel Partition and Soffit Framing: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with manufacturer's standard corrosion-resistant zinc coating.
 2. Steel Studs and Runners: ASTM C 645, in depth indicated.
 - a. Minimum Base Metal Thickness: 0.027 inch (0.7 mm).
 3. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - a. Minimum Base Metal Thickness: 0.027 inch (0.7 mm).
 4. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flange, and in depth indicated.
 - a. Clip Angle: 1-1/2 by 1-1/2 inch (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.
 5. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Panel Size, General: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- C. Gypsum Wallboard: ASTM C 36.
1. Regular Type: In thickness indicated and with long edges tapered.
 2. Type X: In thickness indicated and with long edges tapered.
- D. Sag-Resistant Gypsum Wallboard: ASTM C 36, manufactured to have more sag resistance than regular-type gypsum board, 1/2-inch (12.7-mm) thick, and with long edges tapered. Apply on ceiling surfaces.
- E. Interior Trim: ASTM C 1047.
1. Cornerbead: Use at outside corners, unless otherwise indicated.

2. LC-Bead (J-Bead): Use at exposed panel edges.
- F. Joint Treatment Materials, General: Comply with ASTM C 475.
- G. Joint Tape:
1. Interior Gypsum Wallboard: Paper.
- H. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, flanges of trim accessories, and fasteners, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- I. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- J. Auxiliary Materials: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
1. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 2. Isolation Strip at Exterior Walls:
 - a. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - b. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.
 3. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1.3 EXECUTION

- A. Installing Steel Framing, General: Comply with ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Installing Steel Partition and Soffit Framing:

1. Where studs are installed directly against exterior walls, install isolation strip between studs and wall.
 2. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 3. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb, unless otherwise indicated.
 - b. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
 4. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- C. Polyethylene Vapor Retarder: Install to comply with requirements specified in Division 7 Section "Building Insulation."
- D. Gypsum Board Application: Comply with ASTM C 840 and GA-216.
1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
 2. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.
 3. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 4. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
 5. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
 6. Laminating to Substrate: Comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- E. Installing Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

- F. Finishing Gypsum Board Assemblies: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
1. Prefill open joints and damaged surface areas.
 2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
 3. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 - a. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.

END OF SECTION 09260

SECTION 09653

RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes resilient the following:

1. Wall base.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: For each product and for each color, pattern, and texture required.

1.3 PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C) in spaces to receive resilient accessories for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods.
1. After postinstallation period, maintain a temperature of not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- B. Install resilient accessories after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 WALL BASE

- A. Wall Base: Rubber, FS SS-W-40, Type I.
1. Color and Pattern: As selected from manufacturer's full range.
 2. Style: Cove with top-set toe.
 3. Minimum Thickness: 1/8 inch (3.2 mm).
 4. Height: 4 inches (101.6 mm).
 5. Lengths: Cut lengths 48 inches (1219.2 mm) long or coils in lengths standard with manufacturer, but not less than 96 feet (29.26 m).
 6. Outside Corners: Job formed or premolded.
 7. Inside Corners: Job formed or premolded.

8. Surface: Smooth.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installing resilient wall base:
 1. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 2. Move resilient products and installation accessories into spaces where they will be installed at least 48 hours before installation, unless longer conditioning periods are recommended in writing by manufacturer. Install products only after they are at the same temperature as the space where they are to be installed.
 3. Broom and vacuum clean substrates to be covered immediately before installing resilient products. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Adhesively install resilient wall base. Place resilient products so they are butted to adjacent materials.
- C. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
 2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 3. Do not stretch base during installation.
 4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
- D. Immediately after installing resilient products, remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.

END OF SECTION 09653

SECTION 09900

PAINTING

1.1 GENERAL

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Contracting Officer or authorized representative will select from standard colors and finishes available.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- D. Submittals: For each paint system specified, provide the following:
 - 1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
- E. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- F. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.
- G. 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 in clean condition, free of foreign materials and residue. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

- H. Project Conditions: Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.2 PRODUCTS

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- C. Colors: Provide color selections made by the Contracting Officer's Representative.

1.3 EXECUTION

- A. Examine substrates, areas, and conditions under which painting will be performed for compliance with paint application requirements. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates.
- C. Preparation: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- D. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- E. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
 - 1. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.

- a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
 2. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- F. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 2. Use only thinners approved by paint manufacturer and only within recommended limits.
- G. Application: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in items are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 7. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 8. Sand lightly between each succeeding enamel or varnish coat.
- H. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- I. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - J. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
 - K. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
 - L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
 - M. Field Quality Control: The Government reserves the right to engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.
 1. The testing agency will perform appropriate tests as required by the Government.
 2. If tests show material being used does not comply with specified requirements, the Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.
 - N. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.
 - O. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by the Contracting Officer or authorized representative.
 - P. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

Q. Paint Schedule: As noted on Drawings.

END OF SECTION 09900

SECTION 13916

FIRE-SUPPRESSION SPRINKLERS

1.1 GENERAL

- A. Design sprinkler working plans and obtain approval from authorities having jurisdiction.
- B. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction:
 - 1. Include 10 percent margin of safety for available water flow and pressure.
 - 2. Sprinkler Occupancy Hazard Classifications: As follows:
 - a. Storage Areas: Storage Occupancy.
 - b. Office Areas: Ordinary Hazard, Group I.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design: As follows:
 - a. Storage Occupancy: 0.20 gpm/sq. ft. over 1,500 sq. ft. area (12.7ml/s over 140 sq. m.) Increase remote area by 30% for dry system to 1,950 sq. ft. (182 sq. m.).
 - b. Ordinary Hazard, Group I Occupancy: 0.15 gpm over 1,500-sq. ft. (9.5 ml/s over 140-sq. m) area.
 - 4. Maximum Protection Area per Sprinkler: As follows:
 - a. Storage Areas: 100 sq. ft. (9.3 sq. m.)
 - b. Office Areas: 130 sq. ft. (12.1 sq. m.)
 - c. In-Rack: 8 ft on center maximum spacing.
- C. Components and Installation: Capable of producing piping systems with 175-psig (1200-kPa) minimum working-pressure rating.
- D. Submittals: Submit the following:
 - 1. Product Data: For valves (NRS, OS&Y, butterfly, check, alarm check, dry alarm), piping materials, and fittings, hangers and upper attachments, water motor gong, pressure switches, tamper switch, flow switch, sprinkler head guards, fire department connection, air compressor, and all sprinklers.
 - 2. Warranty: provide manufacturer's written warranty for pipe, pipe fittings, pipe couplings, and sprinkler heads.
 - 3. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction. Include hydraulic calculations.
 - 4. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping", purging and disinfecting reports, and hydrostatic tests.

5. Provide operating instructions for the dry alarm valve, air compressor, flow switch, tamper switch, and water motor gong.
- E. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.
 - F. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorized government representative. All components shall be by same manufacturer.
 - G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
 - H. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:
 1. NFPA 13-1999, "Standard for the Installation of Sprinkler Systems."

1.2 PRODUCTS

- A. Piping: Refer to "Piping Applications" Paragraph for applications of pipe, tube, fitting, and joining materials.
- B. Standard-Weight Steel Pipe: Black steel and galvanized, ASTM A 53, ASTM A 135, or ASTM A 795; Schedule 40 in NPS 6 (DN150) and smaller, and Schedule 30 in NPS 8 (DN200) and larger.
- C. Cast-Iron Threaded Flanges: ASME B16.1.
- D. Cast-Iron Threaded Fittings: ASME B16.4.
- E. Malleable-Iron Threaded Fittings: ASME B16.3.
- F. Steel, Threaded Couplings: ASTM A 865.
- G. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.
- H. Steel Flanges and Flanged Fittings: ASME B16.5.
- I. Steel, Grooved-End Fittings: UL-listed and FM-approved, ASTM A 47 (ASTM A 47M), malleable iron or ASTM A 536, ductile iron; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.
- J. Transition Couplings: AWWA C219, sleeve type, or other manufactured fitting the same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

- K. Fire-Protection-Service Valves: UL listed and FM approved, with minimum 175-psig (1200-kPa) nonshock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.
1. Gate Valves, NPS 2 (DN50) and Smaller: UL 262; cast-bronze, threaded ends; solid wedge; OS&Y; and rising stem.
 2. Indicating Valves, NPS 2-1/2 (DN65) and Smaller: UL 1091; ball-type, bronze body with threaded ends; and integral indicating device.
 3. Gate Valves, NPS 2-1/2 (DN65) and Larger: UL 262, iron body, bronze mounted, taper wedge, OS&Y, and rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.
 4. Swing Check Valves, NPS 2 (DN50) and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.
 5. Swing Check Valves, NPS 2-1/2 (DN65) and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.
- L. Alarm Check Valves: UL 193, 175-psig (1200-kPa) working pressure, designed for horizontal or vertical installation, with cast-iron flanged inlet and outlet, or grooved outlet, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for bypass, drain, electric sprinkler system alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer, drains shall be closed type.
- M. Dry-Pipe Valves: UL 260; differential type; 175-psig (1200-kPa) working pressure; with cast-iron flanged inlet and outlet, bronze seat with O-ring seals, and single-hinge pin and latch design. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment. Valve shall have external reset.
1. Option: Grooved-end connections for use with keyed couplings.
 2. Air-Pressure Maintenance Devices: Automatic device to maintain correct air pressure in piping. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) maximum inlet pressure.
 3. Air Compressor: Tank mounted, fractional horsepower, 120-V ac, 60 Hz, single phase. Size to pressurize system in 30 minutes.
- N. Ball Drip Valves: UL 1726, automatic drain valve, NPS 3/4 (DN20), ball check device with threaded ends.
- O. Automatic Sprinklers: With heat-responsive element complying with the following:
1. UL 199, for applications except residential.
- P. Sprinkler Types and Categories:
1. Nominal 1/2-inch (12.7-mm) orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

2. Nominal 17/32" (13.5 mm) orifice for "High" temperature classification rating (286 degrees F) minimum operating pressure of 7 psi, unless otherwise indicated or required by application.
- Q. Sprinkler types, features, and options include the following:
1. Pendent Sprinklers
 2. Upright Sprinklers
- R. Sprinkler Finish: Chrome-plated and Bronze.
- S. Sprinkler Escutcheons: Chrome-plated steel, one piece, flat, unless otherwise indicated.
- T. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.
- U. Sprinkler Shields: 4" diameter shields, UL listed for upright or pendent as required by application for in-rack sprinklers.
- V. Specialty Sprinkler Fittings: UL listed and FM approved; made of steel, ductile iron, or other materials compatible with piping.
- W. Locking-Lug Fittings: Unacceptable.
- X. Mechanical-Cross Fittings: UL 213, ductile-iron housing with pressure-responsive gaskets, bolts, and threaded or locking-lug outlets.
- Y. Drop-Nipple Fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.
- Z. Sprinkler, Drain and Alarm Test Fittings: UL-listed, cast- or ductile-iron body; with threaded inlet and outlet, test valve, and orifice and sight glass.
- AA. Sprinkler, Branch-Line Test Fittings: UL-listed, brass body; with threaded inlet and capped drain outlet and threaded outlet for sprinkler.
- BB. Sprinkler, Inspector's Test Fittings: UL-listed, cast- or ductile-iron housing; with threaded inlet and drain outlet and sight glass.
- CC. Wall, Fire Department Connections: UL 405; cast-brass body with brass, wall, escutcheon plate; brass, lugged caps with gaskets and brass chains; and brass, lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking "AUTO SPKR."
1. Type: Exposed Mounting.
 2. Escutcheon Plate: Rectangular.
 3. Finish: Rough, chrome plated.

- DD. Water-Motor-Operated Alarms: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- (250-mm-) diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 (DN20) inlet and NPS 1 (DN25) drain connections.
- EE. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig (1725-kPa) pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- FF. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position. Weatherproof enclosure for post indicator and vault locations.
- GG. Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch- (90- to 115-mm-) diameter dial with dial range of 0 to 250 psig (0 to 1725 kPa).

1.3 EXECUTION

- A. Preparation: Fire-hydrant flow tests are indicated on Drawing F2. Use results for system design calculations. Any additional tests shall be performed by base personnel.
- B. Piping Applications: Use according to the following:
 1. Do not use welded joints with galvanized steel pipe.
 2. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
 3. Piping between Fire Department Connections and Check Valves: Use galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.
 4. Underground Service-Entrance Piping: See Section 02510.
 5. Wet Sprinkler Feed Mains and Risers: Use the following:
 - a. NPS 4 (DN100) and Smaller: Galvanized, standard-weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
 - b. NPS 5 and NPS 6 (DN125 and DN150): Galvanized, standard-weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
 6. Dry-Pipe Branch Piping Sprinklers: Use the following:
 - a. NPS 1-1/2 (DN40) and Smaller: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.

- b. NPS 2 (DN50): Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.
 - c. NPS 2 (DN50): Galvanized, standard-weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
 - d. NPS 2-1/2 to NPS 4 (DN65 to DN100): Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.
 - e. NPS 2-1/2 to NPS 4 (DN65 to DN100): Galvanized, standard-weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
- C. Valve Applications: Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Fire-Protection-Service Valves: UL listed and FM approved for applications where required by NFPA 13.
 - a. Shutoff Duty: Use gate valves.
 - 2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 13.
 - a. Shutoff Duty: Use gate valves.
- D. Joint Construction:
 - 1. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut-grooved ends and Schedule 30 or thinner steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
 - 2. Locking-Lug-Fitting, Twist-Locked Joints: Unacceptable.
 - 3. Provide "Mega-Lug" flange on service entrance piping for connection of interior flanged piping.
- E. Service-Entrance Piping: Connect interior sprinkler piping to underground water-service piping of size and in location indicated on drawing detail A/F3 for service entrance to building. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-service piping.
- F. Piping Installation:
 - 1. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical. Deviations from approved working plans for piping require written approval from authorized government representative. File written approval before deviating from approved working plans.
 - 2. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
 - 3. Install unions adjacent to each valve in pipes NPS 2 (DN50) and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

4. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 (DN65) and larger connections.
 5. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
 6. Install sprinkler piping with drains for complete system drainage.
 7. Install alarm devices in piping systems.
 8. Hangers and Supports: Comply with NFPA 13 for hanger materials and installation. All hangers and upper attachments shall be UL listed and FM approved.
 9. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.
 10. Install pressure gages on riser or feed main and at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 (DN8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
 11. Install specialty sprinkler fittings according to manufacturer's written instructions.
 12. Install galvanized piping on dry sprinkler system and between check valve and fire department connection.
- G. Valve Installation: Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13, manufacturer's written instructions, and authorities having jurisdiction.
1. Gate Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.
 2. Dry Alarm and Alarm Check Dry Valves: Install valves in vertical position for proper direction of flow, including bypass check valve and retard chamber drain-line connection.
- H. Sprinkler Applications: Use sprinklers according to the following:
1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Pendent sprinklers.
 3. In-Rack Sprinklers: Upright in areas subject to freezing and pendants in heated areas.
 4. Spaces Subject to Freezing (Building 3420 Warehouse): Upright; pendent, dry type sprinklers.
 5. Sprinkler Finishes: Use sprinklers with the following:
 - a. Upright and Pendent Sprinklers: Chrome Plated in finished spaces exposed to view and rough bronze in unfinished spaces.
- I. Connect water supplies to sprinklers.
- J. Install ball-drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- K. Connect piping to specialty valves, specialties, and accessories.

- L. Electrical Connections: Power wiring is specified in Division 16.
- M. Connection of alarm devices to fire alarm will be performed by Division 16.
- N. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13. This includes hydraulic design information sign.
- O. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.

END OF SECTION 13916

SECTION 13921

ELECTRIC-DRIVE, HORIZONTAL FIRE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes electric-drive, single-stage, horizontally mounted, split-case fire pumps for building fire-suppression systems.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, certified pump performance curves with each selection point indicated, furnished specialties, and accessories for each fire-pump and pressure-maintenance-pump unit and controllers.
- B. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and maintenance data for fire pump and controller.
- D. Warranty: for fire pump and controller.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms whose fire pumps, pressure-maintenance pumps, drivers, controllers, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FMG's "Fire Protection Approval Guide" and that comply with requirements indicated. The following are exceptions and are not required:
 - 1. UL listing and FMG approval of pressure-maintenance pumps.
 - 2. FMG approval of pressure-maintenance-pump controllers.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 20, "Centrifugal Fire Pumps," for fire pumps, drivers, controllers, accessories, and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 SINGLE-STAGE, HORIZONTALLY MOUNTED, SPLIT-CASE FIRE PUMPS

- A. Description: UL 448, factory-assembled and -tested, electric-drive, double-suction, horizontal type. Include pump and driver mounted on same base and connected with coupling.
1. Manufacturers (or approved equal):
 - a. Armstrong Darling, Inc.
 - b. Fairbanks Morse Pump Corp.
 - c. General Signal Pump Group; Aurora Pump Unit.
 - d. ITT Fluid Technology Corp.; ITT A-C Pump Unit.
 - e. Paco Pumps, Inc.
 - f. Patterson Pump Co.
 - g. Peerless Pump Co.
 2. Characteristics: Capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head. Shutoff head is limited to 140 percent of total rated head.
 3. Casing: Axially split cast iron with suction and discharge flanges machined to ASME B16.1, Class 125 dimensions, unless Class 250 flanges are indicated.
 4. Impeller: Cast bronze of construction to match fire pump, statically and dynamically balanced, and keyed to shaft.
 5. Wear Rings: Replaceable, bronze.
 6. Shaft and Sleeve: Steel shaft with bronze sleeve.
 7. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 8. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 9. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
 10. Driver: Electric motor. 480V/3&.
 11. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
 12. Nameplate: Complete with capacities, characteristics, and other pertinent data.

2.3 PRESSURE-MAINTENANCE PUMPS

- A. Description: Factory-assembled and -tested, electric-drive pumps with cast-iron or stainless-steel casing and bronze or stainless-steel impellers and mechanical seals. Include flanged suction and discharge flanges machined to ASME B16.1, Class 125

dimensions, unless Class 250 flanges are indicated and except that connections may be threaded in sizes where flanges are not available. Comply with HI 1.1-1.5 requirements for regenerative-turbine centrifugal pumps. Include base, manufacturer's standard color paint, and nameplate.

1. Manufacturers:

- a. Crane Pumps & Systems, Inc.
- b. Fairbanks Morse Pump Corp.
- c. General Signal Pump Group; Aurora Pump Unit.
- d. Grundfos Pumps Corp.
- e. Paco Pumps, Inc.

- B. Pump Drivers: NEMA MG 1, open-dripproof, squirrel-cage, induction motor. Include construction complying with NFPA 20 and NFPA 70, and include wiring compatible with controller used, manufacturer's standard red paint, and nameplate.

2.4 PUMP CONTROLLERS

- A. Description: Combined automatic and nonautomatic operation; factory assembled and wired; factory tested for capacities and electrical characteristics; and with the following features:

1. Manufacturers:

- a. Firetrol, Inc.
- b. Hubbell Industrial Controls, Inc.
- c. Joslyn Clark Controls, Inc.
- d. Master Control Systems, Inc.
- e. Metron, Inc.

2. Enclosure: UL 50, Type 2, dripproof, indoor.
3. Controls, devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
4. Nameplate: Complete with capacity, characteristics, approvals and listings.
5. Controller Sensing Pipes: Fabricate according to NFPA 20.

- B. Full-Service, Fire-Pump Controllers: UL 218 and NFPA 20; listed for electric-drive, fire-pump service and service entrance.

1. Type Starting: Wye-delta, closed transition.
2. Rate controllers for scheduled horsepower. Include short-circuit withstand rating at least equal to short-circuit current available at controller location. Take into account cable size and distance from substation or supply transformers.
3. Controllers: As follows:
 - a. Isolating means and circuit breaker.
 - b. "Power on" pilot lamp.
 - c. Fire alarm system connections for indicating motor running condition, loss-of-line power, and line-power phase reversal.

- d. Automatic and manual operation, and minimum run-time relay to prevent short cycling.
 - e. Automatic and manual shutdown.
 - f. System pressure recorder, electric ac driven with spring backup.
 - g. Mounting: Floor-stand type for field electrical connections.
 - h. Enclosure Finish: Manufacturer's standard red paint.
- C. Pressure-Maintenance-Pump Controllers: UL 508; factory-assembled, -wired, and -tested across-the-line type for combined automatic and nonautomatic operation.
- 1. Manufacturers:
 - a. Firetrol, Inc.
 - b. Hubbell Industrial Controls, Inc.
 - c. Joslyn Clark Controls, Inc.
 - d. Master Control Systems, Inc.
 - e. Metron, Inc.
 - 2. Enclosure: UL 508 and NEMA 250, Type 2, wall-mounting type for field electrical wiring.
 - 3. Rate controller for scheduled horsepower and include fusible disconnect switch, pressure switch, hand-off-auto selector switch, pilot light, running period timer, and manufacturer's standard color paint.

2.5 FIRE-PUMP SPECIALTIES AND ACCESSORIES

- A. Match fire-pump suction and discharge ratings as required for fire-pump capacity rating. Include the following:
- 1. Automatic air-release valve.
 - 2. Circulation relief valve.
 - 3. Suction and discharge pressure gages.
 - 4. Eccentric-tapered reducer at suction inlet.
 - 5. Concentric-tapered reducer at discharge outlet.
 - 6. Test-Header Manifold: Ductile-iron or brass body for hose valves. Include nozzle outlets arranged in single line; horizontal, flush-wall mounting attachment; and rectangular, brass escutcheon plate with lettering equivalent to "PUMP TEST CONNECTION."
 - 7. Escutcheon Plate Finish: Rough chrome-plated.
 - 8. Hose Valves: UL 668, straightway pattern, bronze with cap and chain. Include NFPA 1963 hose thread that complies with local fire department standards and finish same as for test-header-manifold escutcheon plate.
 - 9. Ball Drip Valve: UL 1726.
 - 10. Main Relief Valve: UL 1478, none required.

2.6 PRESSURE-MAINTENANCE-PUMP SPECIALTIES AND ACCESSORIES

- A. Match pressure-maintenance-pump suction and discharge ratings as required for pump capacity rating. Include circulation relief valve and suction and discharge pressure gages.

2.7 SOURCE QUALITY CONTROL

- A. Factory Tests: Hydrostatically test and test run fire pumps before shipping. Test at 150 percent of shutoff head plus suction head, but not less than 250 psig (1725 kPa). Produce certified test curves showing head capacity and brake horsepower of each pump.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install concrete bases of dimensions indicated for fire pumps, pressure-maintenance pumps, and controllers. Refer to Division 3 Section "Cast-in-Place Concrete".
- B. Comply with fire-pump, pressure-maintenance-pump, and controller manufacturers' written installation and alignment instructions, and with NFPA 20.
- C. Install pumps and controllers to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- D. Set pumps on concrete bases. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
 - 1. Support pump baseplate on rectangular metal blocks and shims or on metal wedges having small taper, at points near foundation bolts to provide 3/4- to 1-1/2-inch (19- to 38-mm) gap between pump base and foundation for grouting.
 - 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and pump suction and discharge flanges to verify that they are level and plumb.
- E. Install suction and discharge piping equal to or greater than diameter of fire-pump nozzles.
- F. Install valves that are the same size as piping connecting fire pumps, bypasses, test headers, and other piping systems.
- G. Install pressure gages on fire-pump suction and discharge at pressure-gage tappings.
- H. Support pumps and piping separately so weight of piping does not rest on pumps.
- I. Install piping accessories, hangers and supports, anchors, valves, meters and gages, and equipment supports.
- J. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copies of manufacturers' wiring diagram

Submittals to electrical Installer. Verify that electrical wiring is installed according to manufacturers' submittal and installation requirements in Division 16 Sections. Proceed with equipment startup only after wiring installation is satisfactory.

3.2 ALIGNMENT

- A. Align fire-pump and driver shafts after complete unit has been leveled on foundation, grout has set, and foundation bolts have been tightened.
 - 1. After alignment is correct, tighten foundation bolts evenly but not too firmly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten foundation bolts after grout has hardened. Check alignment and make required corrections.
 - 2. Make piping connections, check alignment, and make required corrections. Adjust alignment of pump and driver shafts for angular and parallel alignment by one method in HI 1.1-1.5, Section 1.4, "Installation, Operation and Maintenance." Comply with manufacturer's written instructions for alignment tolerances.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 13 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
 - 1. Install piping adjacent to fire and pressure-maintenance pumps to allow service and maintenance.
 - 2. Connect water supply to fire and pressure-maintenance pumps.
 - 3. Connect fire-pump and pressure-maintenance-pump discharge piping to building fire-suppression piping.
 - 4. Connect circulation relief-valve discharge to point of disposal.
- B. Connect fire-pump controllers to building fire alarm system. Refer to Division 13 Section "Fire Alarm."
- C. Connect controllers to pumps.
- D. Electrical wiring and connections are specified in Division 16 Sections.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including fire-pump and pressure-maintenance-pump units, piping, and electrical connections. Report results in writing.
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Perform field tests for each fire-pump unit and system piping when installation is complete. Comply with operating instructions and procedures in NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or that does not perform as indicated, then retest to demonstrate compliance. Verify that each fire-pump unit performs as indicated. Report test results in writing.

END OF SECTION 13921

SECTION 16002

ELECTRICAL GENERAL PROVISIONS

1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Electrical Requirements section, and is part of each Division 16 section making reference to electrical related work specified herein.

1.2 RELATED SECTIONS

- A. 16060 - GROUNDING AND BONDING
- B. 16120 - CONDUCTORS AND CABLES
- C. 16124 - MEDIUM VOLTAGE DISTRIBUTION POWER CABLES
- D. 16130 - RACEWAYS AND BOXES
- E. 16140 - WIRING DEVICES
- F. 16182 - FUSES, MEDIUM AND HIGH VOLTAGE
- G. 16350 - MEDIUM-VOLTAGE TRANSFORMERS
- H. 16442 - PANELBOARDS
- I. 16460 - LOW VOLTAGE TRANSFORMERS
- J. 16515 - INTERIOR LIGHTING FIXTURES
- K. 16721 - FIRE DETECTION, ALARM, AND RADIO TYPE REPORTING SYSTEM

1.3 SUMMARY

- A. Work, apparatus, and materials to be furnished under these Specifications and accompanying Drawings include all items listed herein and indicated on the Drawings.
- B. All other materials necessary for installation shall be furnished and installed by this Contractor to provide electrical systems as specified herein and as indicated on the Drawings.
- C. Work to be included under this Section includes, but is not limited to, the following:
 - 1. Extend underground electrical primary distribution system from existing power pole to new pad mounted transformer as indicated on the Drawings.
 - 2. Provide power pole hardware as shown on the drawings.
 - 3. Provide installation of pad-mounted sectionalizing switch and pad-mounted distribution transformer including underground primary cables and conduits as indicated on the Drawings.

4. Provide underground service conductors from pad-mounted transformer to service entrance indoor power panel and fire pump controller.
5. Provide lighting system as indicated on the Drawings.
6. Provide complete indoor lighting systems including lighting fixtures, toggle switches, branch circuits, etc. as indicated on the Drawings.
7. Provide testing, adjusting, and balancing of electrical equipment and systems provided under other electrical specifications.
8. Replacing old fire alarm control panel with new fire alarm control panel. Reconnecting existing fire alarm devices plus adding new manual pull stations, alarm horns, heat detectors, conductors, conduits, outlet boxes, etc. to provide a complete and fully operational system as indicated on the Drawings.
9. Provide complete grounding system as required by the 1999 edition of the National Electrical Code, NFPA 99 and/or as specified in Specification Section 16060 - Grounding and Bonding.

1.4 POWER SERVICE

- A. Permanent primary electrical service is supplied by the base at 12470:480Y/277 volts, three phase, four wire, unless otherwise noted on the Drawings.
- B. Permanent electrical secondary service shall be supplied at 480Y/277 volts, three phase, four wire as shown on the Drawings.

1.5 CONTRACTOR'S QUALIFICATIONS

- A. Contractor shall meet all State and local licensing requirements.
- B. It is assumed that the Contractor has sufficient general knowledge and experience to anticipate the needs of construction of this nature.
 1. Contractor shall provide all items required to complete the construction in accordance with reasonable interpretation of the intent of the Drawings and Specifications.
 2. Any minor items required by code, law or regulations shall be provided whether or not specified or specifically shown where it is a part of a major item of equipment, or of the control system specified or shown on the Drawings.
- C. Before starting work, Contractor shall notify the Contracting Officer or authorized representative of impending construction.

2 - PRODUCTS

2.1 EQUIPMENT DEVIATIONS

- A. Where Contractor proposes to use an item of equipment other than that specified or detailed on the Drawings, which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, all such redesign and all new

drawings and detailing required therefore shall be prepared by the Contractor at his own expense and submitted for approval by the Contracting Officer or authorized representative.

- B. Where such approved deviation requires a different quantity and arrangement of ductwork, piping, wiring, conduit, and equipment from that specified or indicated on the Drawings, the Contractor shall furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the government.

2.2 SUPPORTS AND ATTACHMENTS

- A. Contractor shall furnish and install all necessary supports required for all electrical equipment, lighting fixtures, conduits, outlet boxes, panelboards, generators, and for all other equipment furnished under this contract, and shall submit drawings to the Designer, when required, for approval before purchase, fabrication, or construction of same.
- B. All equipment, unless otherwise shown, shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Designer, not strong enough, shall be replaced as directed.
- C. Framing members shall be standard rolled steel shapes, ASTM A36 steel, except that members welded to main structural member shall be of the same specification as the main structural member. Framing shall be "simple beam" type with end connections welded or bolted for shear loads. Cantilevers may be used when detailed or specifically approved. Location of supplementary framing shall be subject to approval. Welding shall be done by certified welders.
- D. Framing members shall be designed for their actual loads, with allowable stresses set forth in the AISC Specifications and the AISC Code, without excessive deflection and with consideration for rigidity under vibration, in accordance with standard structural practices. Supplementary framing, including design loads, member size and location shall be clearly shown on shop drawings.
- E. When supplementary framing is indicated, verify that dimensions are suitable and that framing is structurally adequate for the equipment furnished.

3 - EXECUTION

3.1 DUTIES OF CONTRACTOR

- A. Drawings are generally diagrammatic and are not intended to show each and every fitting, box, elbow, hanger, etc., or a complete detail of all the work to be done. They are for the purpose of illustrating the type of system, showing conduit sizes, etc., and special conditions considered necessary for the experienced mechanic to take off his materials and lay out his work. This Contractor shall be

responsible for taking such measurement as may be necessary at the job and adapting his work to local conditions.

- B. Contractor shall furnish and install all materials called for in these Specifications and accompanying Drawings, and must furnish the apparatus complete in every respect. Anything called for in the Specifications and not indicated on the Drawings, or indicated on the Drawings and not called for in the Specifications, shall be furnished by the Contractor.
- C. Contractor is responsible for familiarizing himself with the details of the construction of the buildings involved in this project. Work under these Specifications installed improperly or which requires changing due to improper reading or interpretation of building plans shall be corrected and changed as directed by the Designer without additional cost to the Owner.
- D. Contractor shall follow the Drawings in laying out the work and check the Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, Designer shall be notified before proceeding with installation.
- E. Conditions sometimes occur which require certain changes in the Drawings and Specifications.
 - 1. In event that such changes in drawings and specifications are necessary, the same are to be made by the Contractor without additional expense to the Owner, providing such changes do not require furnishing more materials or performing more labor than the true intent of the Drawings and Specifications demand.
 - 2. It is understood that while the Drawings are to be followed as closely as circumstances will permit, the Contractor is held responsible for the installation of the system according to the true intent and meaning of the Drawings.
 - 3. Anything not entirely clear in the Drawings and Specifications will be fully explained if application is made to the Designer. Should, however, conditions arise where in the judgement of the Contractor certain changes will be advisable, the Contractor will communicate with the Designer and secure his approval of these changes before going ahead with the work.
- F. The right to make any responsible change in location of apparatus, equipment, or routing of conduits, up to the time of roughing in, is reserved by the Designer without involving any additional expense to the Owner.
- G. It shall be the duty of prospective bidders to visit the job site and familiarize themselves with job conditions. No extras will be allowed because of additional work necessitated by, or changes in plans required because of evident job conditions that are not indicated on the Drawings.

- H. Contractor shall determine the schedule of work and must schedule his work to maintain the building construction schedule so as not to interfere with or hold up any other trades.
- I. Contractor shall schedule work in order that the existing facility shall be occupied at all times providing all temporary services required.
- J. Contractor shall leave the premises in a clean and orderly manner upon completion of the work day, and shall remove from the premises all debris that has accumulated during the progress of the work day.

3.2 COOPERATION WITH OTHER TRADES

- A. This Contractor shall give full cooperation to other trades and shall furnish any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- B. Where the work of the Contractor will be installed in close proximity to, or may interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment.
 - 1. If so directed by the Designer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 3/8"=1'-0", clearly showing how his work is to be installed in relation to the work of other trades.
 - 2. If the Contractor installs his work before coordination with other trades, he shall make the necessary changes in his work to correct the condition without extra charge.
 - 3. Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

3.3 CODES, RULES, PERMITS AND FEES:

- A. Contractor shall give all necessary notices, pay all sales taxes, and other costs, including utility connections or extensions, in connection with his work, file all necessary plans, prepare all documents, obtain all necessary approvals from all authorities having jurisdiction, obtain all required certificates of inspection for his work and deliver same to the Designer before request for acceptance and final payment for the work.
- B. Contractor shall include in his work, without extra cost to the Owner, any labor, materials, service, apparatus and drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on the Drawings and/or specified.

- C. All materials furnished and all work installed shall comply with National Electrical Code, the National Fire Codes of the National Fire Protection Association, and with the requirements of all governmental departments having jurisdiction.

3.4 UNDERWRITERS LABORATORIES LISTING

- A. All equipment shall be UL listed and/or labeled. No equipment shall be used which fails to meet these conditions.

3.5 TYPICAL MOUNTING HEIGHTS OF DEVICES

- A. Typical mounting heights for electrical equipment shall be as follows unless otherwise noted on the Drawings:

DEVICE	MOUNTING HEIGHT ABOVE FINISHED FLOOR	TO
Panelboards	6'-6"	Top
Toggle switches	4'-0"	Center Line
Receptacles	1'-6"	Center Line
Telephone Outlets (Verify)	1'-6"	Center Line
Safety Switches	6'-6"	Top (Maximum)
Data Outlets	1'-6"	Center Line
Fire Alarm pull Stations	4'-0"	Center Line
Fire alarm Horn/Lights	6'-8"	Center Line

(or 6" BFC, whichever is lower)

- B. Device mounting heights shall be in accordance with the "Americans With Disabilities Act".

3.6 EARTHWORK

- A. Excavating and backfilling inside and outside the building shall include shoring and bracing, pumping and protection for safety of persons and property. Backfill shall be compacted in layers not exceeding 6" in depth.

1. Completed backfill shall conform to surrounding ground and finish grade. Restore any sidewalks, roads, or existing work which is cut or damaged to "as found" conditions.
2. Dispose of excess material in a manner approved by the Designer.

- B. The Drawings for this project show the anticipated underground utilities, when this information is available, at locations where they will not interfere with proposed construction.

1. Wherever trenching or excavating, assume utilities may exist without them being shown on the Drawings.
2. Exercise extreme caution. Should existing facilities be damaged, repair to Designer's satisfaction at no additional cost to the Owner.

3.7 SCHEDULE OF WORK AND INTERRUPTIONS OF ELECTRICAL SERVICE

- A. All work shall be scheduled to cause the least amount of inconvenience to the Owner. Corridors shall be left open for pedestrian traffic at all times.
- B. Power in the existing building with new work shall be interrupted only at times scheduled with and agreed to by the Owner, giving a two day minimum notice.

3.8 PROTECTION OF EXISTING EQUIPMENT

- A. Contractor shall be responsible for the removal and replacement of all equipment in existing buildings where necessary because of electrical work. The Contractor shall take care to protect from damage all walls, windows, floors, etc., and all mechanical systems. Drop cloths shall be used where necessary to protect existing equipment from dust during cutting and drilling.
- B. Any structures, furnishings or mechanical systems damaged in the new or existing buildings during construction shall be repaired or replaced to the satisfaction of the Architect and Owner by the Contractor responsible. This Contractor shall bear the expense of correcting damage or unsatisfactory replacement of system or equipment damaged by his personnel. Where Contractor cannot agree on the responsibility for damaged items, then the Architect shall determine responsibility.

3.9 ELECTRICAL CONNECTIONS

- A. Division 16 Contractor shall be responsible for all power wiring up to a termination point consisting of a junction box, trough, or disconnect switch as applicable.
- B. All control wiring and final motor connections for HVAC equipment shall be the responsibility of the Division 15 Contractor.
- C. Motors and equipment shall be provided for current and voltage characteristics as indicated on the Drawings.

3.10 EQUIPMENT CONNECTIONS

- A. In general, provide electrical power systems connections to all equipment shown on the Drawings. Included are wiring raceways, disconnects, and other devices shown. Control wiring and final motor connections for HVAC systems shall be provided under Division 15.
- B. Control wiring shall be installed in raceways and box system separate from power wiring, unless otherwise indicated on Drawings. Wiring in equipment enclosures shall be in raceways provided under this section of the specifications unless an approved raceway is provided by the manufacturer of the equipment.

3.11 ELECTRICAL PROVISIONS FOR MECHANICAL WORK

- A. Division 16 Contractor shall provide power wiring up to a termination point consisting of a junction box, trough, combination starter, or disconnect switch as applicable.
- B. Division 16 Contractor shall provide line side terminations and termination point devices (junction box, trough, combination starter, or disconnect switch).
- C. Division 15 Contractor is responsible for wiring from this point, through starter (if required) and to make connection to mechanical equipment.

3.12 INSTALLATION OF FIRE-STOPPING SEALANT

- A. Install sealant (including forming, packing, and other accessory materials) to fill openings around electrical items penetrating floors and walls and 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. Provide UL listed mechanical fire stop or UL classified foam sealant.
- B. Maintain all existing fire ratings of walls and floors that are penetrated with new conduit or systems.

3.13 CLEANING UP

- A. In addition to the cleaning up required in the General Conditions, the Contractor shall, at the completion of the work, clean, polish and/or wash all exposed items of materials, equipment and fixtures in his contract so as to leave such items bright and clean.

END OF SECTION 16002

SECTION 16060

GROUNDING AND BONDING

1 - GENERAL

1.1 SUMMARY

- A. Extent of electrical grounding and bonding work is indicated by the Drawings and Schedules and as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.
- B. Type of electrical grounding and bonding work specified in this section includes the following:
 - 1. Solidly grounded.
- C. Applications of electrical grounding and bonding work in this section includes the following:
 - 1. Electrical power systems.
 - 2. Raceways.
 - 3. Enclosures.
 - 4. Equipment.
- D. Refer to other Division 16 sections for wires/cables, electrical raceways, boxes and fittings, and wiring devices which are required in conjunction with electrical grounding and bonding work.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Install grounding and bonding products of firms regularly engaged in the manufacture of these materials, including stranded cable, grounding rods, and bonding jumpers.
- B. Electrical Code Compliance: Comply with the applicable State electrical code requirements of the authority having jurisdiction, and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.
- C. UL Compliance: Comply with applicable requirements of UL Standards No.'s 467, "Electrical Grounding and Bonding Equipment," and 869, "Electrical Service Equipment," pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Standard 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are UL listed and/or labeled for their intended usage.

2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering grounding products which may be incorporated in the work include, but are not limited to, the following (or approved equal):
 - 1. B-Line Systems, Inc.
 - 2. Burndy Corporation.
 - 3. Gould Inc.
 - 4. Ideal Industries, Inc.
 - 5. Thomas & Betts Corp.

2.2 MATERIALS AND PRODUCTS

- A. General: Except as otherwise indicated, provide electrical grounding and bonding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, bonding jumpers, and additional accessories needed for a complete installation.
 - 1. Where more than one type component product meets indicated requirements, selection is Contractor's option.
 - 2. Where materials or components are not indicated, provide products which comply with NEC and UL requirements and with established industry standards for those applications indicated.
- B. Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding system connections that match power supply wiring materials and are sized according to NEC.
- C. Bonding Connectors, Terminals and Clamps: Provide electrical bonding connectors, terminals, lugs and clamps as recommended by bonding connector, terminal and clamp manufacturers for indicated applications.
- D. Electrical Grounding Connection Accessories: Provide electrical insulating tape, bonding straps, as recommended by accessories manufacturers for type service indicated.

3 - EXECUTION

3.1 TESTING

- A. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
- B. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

3.2 EXAMINATION

- A. Examine areas and conditions under which electrical grounding and bonding connections are to be made and notify the Contracting Officer or authorized representative in writing of conditions detrimental to proper completion of work.
- B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.3 INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS

- A. General: Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions and applicable portions of NEC, OSHA, and NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements.
- B. Install grounding systems as designed and submit certified test report on grounding system.
- C. Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.
- D. Provide a separate, insulated equipment grounding conductor from each device to ground buses in panelboards. Terminate each end on a grounding lug, bus, or insulated grounding bushing.
- E. Provide grounding system per the Drawings and Article 250 of the NEC. Provide green equipment grounding conductor for all electrical raceways.
- F. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.
- G. Apply corrosion-resistant finish to field connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.
- H. Provide clamp-on connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.
- I. Provide PVC conduit for ground wire in concrete. Do not use metallic conduit.

END OF SECTION 16060

SECTION 16120

CONDUCTORS AND CABLES

1 - GENERAL

1.1 SUMMARY

- A. Extent of electrical wire and cable work is indicated by the Drawings and Schedules for low voltage wire and cable - 600V and below.
- B. Types of electrical wire, cable, and connectors specified in this section include but are not limited to the following:
 - 1. Copper conductors.
 - 2. Fixture wires.
 - 3. Tap type connectors.
 - 4. Split-bolt connectors.
 - 5. Wirenut connectors.
- C. Applications of electrical wire, cable, and connectors required for this Project include but are not limited to the following:
 - 1. For power distribution circuits.
 - 2. For building lighting circuits.
 - 3. For appliance and equipment circuits.
 - 4. For motor-branch circuits.

1.2 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required.
- B. NEC Compliance: Comply with NEC requirements as applicable to construction, installation and color coding of electrical wires and cables.
- C. UL Compliance: Provide wiring/cabling and connector products which are UL listed and/or labeled.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type wire and cable reels.
- B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
- C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of wire, cable, and connector) (or approved equal):

B. Wire and Cable:

1. American Insulated Wire Corp.
2. Cabelec Corp.
3. General Cable Corp.
4. Okonite Company.
5. Rome Cable Corp.
6. Southwire Company.
7. Triangle PWC, Inc.

C. Connectors:

1. AMP, Inc.
2. Appleton Electric Co.; Emerson Electric Co.
3. Electrical Products Div.; Midland-Ross Corp.
4. Ideal Industries, Inc.
5. 3M Company
6. O-Z/Gedney Co.
7. Square D Company.
8. Thomas & Betts Corp.

2.2 SECONDARY VOLTAGE WIRES, CABLES, AND CONNECTORS

A. General: Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated. Provide copper conductors with conductivity of not less than 98% at 68° F.

B. Building Wires: Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Contractor to comply with project's installation requirements, NEC and NEMA standards. Select from the following UL types, those wires with construction features which fulfill project requirements:

1. Type THW: For dry and wet locations; maximum operating temperature 75 degrees C (167 degrees F). Insulation, flame-retardant, moisture- and heat-resistant, thermoplastic; conductor, annealed copper.
2. Type THWN: For dry and wet locations; maximum operating temperature 75 degrees C (167 degrees F). Insulation, flame-retardant, moisture- and

- heat-resistant, thermoplastic; outer covering, nylon jacket; conductor, annealed copper.
3. Type RHW (Feeders 4/0 and larger and Underground Feeders): For dry and wet locations; maximum operating temperature 75 degrees C (167 degrees F). Insulation, moisture- and heat-resistant EP rubber; outer covering, moisture-resistant, flame-retardant, nonmetallic covering; conductor, annealed copper.
 4. Type THHN (Interior Branch Circuits): For dry and damp locations; maximum operating temperature 90 degrees C (194 degrees F). Insulation, flame-retardant, heat-resistant, thermoplastic; outer covering, nylon jacket; conductor, annealed copper.
- C. Cables: Provide UL type factory-fabricated cables of sizes, ampacity ratings, and materials and jacketing/sheathing as indicated for services indicated. Where not indicated, provide proper selection as determined by Contractor to comply with installation requirements, NEC and NEMA standards.
- D. Conductors No. 10 and smaller may be solid or stranded and conductors larger than No. 10 shall be stranded. Control wire shall be stranded copper.
- E. Connectors:
1. General: Provide UL type factory-fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated.
 2. Where not indicated, provide proper selection as determined by the Installer to comply with the project's installation requirements, and with NEC and NEMA standards.
 3. Select from the following, those types, classes, kinds and styles of connectors to fulfill project requirements:
 - a. Type: Pressure, threaded.
 - b. Class: Insulated.
 - c. Kind: Copper (for Cu to Cu connection).
 - d. Style: Tap, pigtail, wirenut, split bolt, T-connections.

3 - EXECUTION

3.1 TESTING

3.1 INSTALLATION OF WIRES AND CABLES

- A. General: Install wires and wiring connectors as indicated, in compliance with applicable requirements of NEC, NEMA, OSHA, UL, and NECA's "Standard of Installation," and in accordance with recognized industry practices.
- B. Coordinate wire/cable installation work including electrical raceway and equipment installation work, as necessary to properly interface installation of wires/cables with other work.

- C. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring (fire alarm).
- D. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 50 feet, unless otherwise noted on the Drawings.
- E. Place an equal number of conductors for each phase of a circuit in same raceway, unless indicated otherwise on the Drawings.
- F. Neatly train and lace wiring inside boxes, equipment and panelboards.
- G. Make conductor lengths for parallel circuits equal.
- H. Conductors shall be color coded; (1) ground leads, green; (2) grounded neutral leads, white (120 volts); (3) ungrounded phase wires, black, red, and blue (208Y/120V); (4) ungrounded phase wires, brown, orange, and yellow (480Y/277V); (5) switch leg travellers, purple.
- I. Install exposed cables parallel and perpendicular to surfaces, or exposed structural members, and follow surface contours, where possible.
- J. Completely and thoroughly swab raceway system before installing conductors.
- K. Branch circuit wiring shall not loop through receptacle terminals, but shall be connected by means of conductor taps joined to branch circuit conductors. At end of run, branch circuit conductors may terminate on receptacle terminals.
- L. Position all splices in pull boxes and junction boxes of adequate volume so they are accessible from the removable cover side of the box.
- M. Conductors for signal systems shall be continuous and shall be terminated on terminal strips or terminate in a manner approved by the system's manufacturer.
- N. All neutrals and ground wires in panels shall be labeled with numbered tape to indicate the circuits being served.
- O. Pull conductors simultaneously where more than one is being installed in same raceway.
- P. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.
- Q. Use pulling means including fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway.
- R. Keep conductor splices to minimum.
- S. Install splices and taps which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

- T. Use splice and tap connectors which are compatible with conductor material.
- U. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A and B.
- V. Conductors manufactured more than twelve months prior to date of delivery to site shall not be used.

3.2 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible junction boxes.
- B. Splices, taps and attachments of fittings and lugs shall be electrically and mechanically secure. Connectors and lugs shall be correct size for conductors joined.
- C. Solid conductors, namely those sized No. 10 AWG copper, and smaller, shall be spliced by using Ideal "Wing-Nuts," 3M Co.'s "Scotchlox" or T&B "Piggy" conductors (or approved equal) in junction boxes and light fixtures, except recessed fixtures as noted below.
 - 1. "Sta-Kon" or other permanent type crimp connectors shall not be used.
 - 2. Contractor shall use Ideal "Wing-Nuts" for splicing recessed lighting fixture leads to branch circuit conductors.
- D. Stranded conductors, namely No. 8 AWG and larger, shall be spliced by UL listed mechanical connectors plus gum tape, plus friction or plastic tape. Solderless mechanical connectors, for splices and tape provided with UL listed insulating covers, may be used instead of mechanical connectors plus tape.
- E. Conductors, in all cases, shall be continuous from outlet to outlet, and no splicing shall be made except within outlet or junction boxes, troughs, and gutters.
- F. Lugs for conductors No. 6 through No. 1/0 AWG shall be copper, split bolt type with spacer. Lugs for connectors No. 2/0 AWG and larger shall be copper 2-bolt type with spacer. Lugs shall be as manufactured by AMP, Inc. (or approved equal).
- G. Taping of joints shall be made using special oil resistant vinyl plastic tape; UL listed, rated 105° C, Scotch Electrical Tape No. 33+ or reviewed equal.
- H. Splices in grounding conductors No. 8 AWG and larger shall be by means of exothermic welding and termination shall be by means of approved grounding connectors. Soldering shall not be used.
- I. Thoroughly clean wires before installing lugs and connectors.

- J. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- K. Terminate spare conductors with electrical tape.

3.3 FIELD QUALITY CONTROL

- A. Prior to energization, test wires and cables for electrical continuity and for short circuits. Verify proper phasing connections.
- B. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

3.4 WIRE AND CABLE INSTALLATION SCHEDULE

- A. Exposed Interior Locations: Building wire in raceway.
- B. Above Accessible Ceilings: Building wire in raceway.
- C. Exterior Locations: Building wire in raceway.
- D. Underground Locations: Building wire in raceway.

END OF SECTION 16120

SECTION 16124

MEDIUM VOLTAGE DISTRIBUTION POWER CABLES

1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. Extent of electrical primary voltage distribution cable work is indicated by Drawings.
- B. Types of electrical cable, and connectors specified in this section include the following:
 - 1. Copper conductors.
 - 2. Primary conductor terminators.
- C. Applications of electrical wire, cable, and connectors required for this project are as follows:
 - 1. For primary power distribution circuits from pole to pad mounted transformer.

1.3 QUALITY ASSURANCE

- A. NEC Compliance: Comply with NEC requirements as applicable to construction, installation and color coding of electrical wires and cables.
- B. NEMA/ICEA Compliance: Comply with NEMA/ICEA Std. Pub/No.'s S68-516, and WC-8, pertaining to electrical power type cables.
- C. IEEE Compliance: Comply with applicable requirements of IEEE Stds. 82, "Test Procedures for Impulse Voltage Tests on Insulated Conductors."
- D. ASTM Compliance: Comply with applicable requirements of ASTM B1, 2, 3, 8 and D-753. Provide copper conductors with conductivity of not less than 98% at 68° F.
- E. Warranty: Primary cables shall be provided with 25 year certified manufacturer's warranty which shall be submitted with submittals after award of contract.
- F. Prior to installation, Contractor shall furnish from each reel of cable, shipped and delivered to the project, a certified manufacturer's test report for approval by the Contracting Officer or authorized representative.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver cable properly wound on NEMA-specified type cable non-returnable reels.
- B. Store cable in clean dry space in original reels. Protect products from weather, damaging fumes, construction debris and traffic.
- C. Handle cable carefully to avoid abrasing, puncturing and tearing cable insulation and sheathing. Ensure that dielectric resistance integrity of cables is maintained.

2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (or approved equal) (for each type of wire, cable, and connector):
- B. Wire and Cable:
 - 1. Kerite Company
 - 2. Okonite Company
 - 3. Southwire Company
- C. Terminators and Splices:
 - 1. Electrical Products Div.; Midland-Ross Corp.
 - 2. G&W Electric Specialty Company.
 - 3. 3M Company
 - 4. Raychem

2.2 CABLES AND TERMINATORS

- A. General: Provide electrical primary cables, and terminators of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 68° F.
- B. Cables: Provide factory-fabricated primary cables of sizes, ampacity ratings, and materials and jacketing/sheathing as indicated. Cable shall be Cablec Unishield EP (AP19161) or approved equal.
- C. Primary voltage power cable shall be rated for 15,000 volts, grounded neutral, and shall be single conductor jacketed, tape type shielding, Class "B" stranded copper insulated with ozone, heat and moisture resistant thermosetting compound ethylene-propylene rubber insulation, non-carbon filled, over semi-conducting strand shield compound or tape, 133% insulation level.

1. The over-all jacket or sheath shall be oil, acid, alkali, and sunlight resistant poly-vinyl-chloride (PVC) which shall be rated for use in underground conduit and ducts.
2. Cable shall be rated for normal operation at a maximum conductor temperature of 90° C.
3. The physical properties and thickness of the insulation and sheath, as well as testing methods, shall comply with the requirements of IPCEA Specifications, Standard S68-516, NEMA Publication No. WC-8.

2.3 CABLE TERMINATORS:

- A. General: Provide factory-fabricated, conductors termination kits of sizes, ampacity ratings, materials, types and classes for applications and for services indicated.
- B. Terminators shall be G&W Slip-On II type with porcelain insulator, brass body, and copper eyebolt options, cat. no. S71B2AK1002BE for single conductor copper cable with tape shield for outdoor terminations on riser pole crossarms.
- C. Raychem 15KV heat shrink type for outdoor terminations in transformers.

3 - EXECUTION

3.1 TESTING

- A. Test primary voltage distribution power cables in accordance with Section 16010 - BASIC ELECTRICAL REQUIREMENTS.

3.2 INSTALLATION OF CABLES

- A. General: Install electrical cables, splices and terminators as indicated, in compliance with applicable requirements of NEC, NEMA, OSHA, UL, and NECA's "Standard of Installation," and in accordance with recognized industry practices.
- B. Coordinate cable installation work including electrical raceway and equipment installation work, as necessary to properly interface installation of cables with other work.
- C. Prior to installation, Contractor shall furnish from each reel of cable delivered to the project, a certified manufacturer's test report for approval by the Contracting Officer or authorized representative.
- D. Cable shall be installed in continuous lengths. Splices are to be permitted only in sectionalizing switches as indicated on the Drawings. Keep cable splices to minimum. Use splice and terminators which are compatible with conductor material.

- E. All splices and terminations, including stress cones for cable as required, unless specified otherwise, are to be fabricated in accordance with cable and termination manufacturer's recommendations or in accordance with the details of such fabrication as included on the Drawings.
- F. Pull conductors simultaneously where more than one is being installed in same raceway.
- G. Contractor shall observe cable manufacturer's recommended minimum values for bending radii to which insulated cables may be bent during installation. Larger radii bends may be required for such conditions in order to limit sidewall pressure.
- H. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.
- I. Use pulling means including fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway.
- J. Install splices and tapes which possess equivalent-or-better mechanical strength and insulation ratings than conductors being spliced.
- K. Tighten electrical terminals, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A and B.

3.3 FIELD QUALITY CONTROL

- A. Prior to energization of circuitry, check installed cables with meter to determine insulation resistance levels to ensure requirements are fulfilled.
- B. Provide fireproof tape wrapping on each conductor in manholes, Scotch 77, unsupported elastomer, self-extinguishing, 30 mils thick.
- C. Prior to energization, test cables for electrical continuity and for short-circuits and make Hi Pot tests with certified findings recorded on all primary distribution cables.
- D. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 16124

SECTION 16130

RACEWAYS AND BOXES

1 GENERAL

1.1 SUMMARY

- A. Extent of raceway, boxes and associated fittings work is indicated by the Drawings and Schedules.
- B. Types of raceways specified in this section include the following:
 - 1. Flexible metal conduit.
 - 2. Liquid-tight flexible metal conduit.
 - 3. Rigid steel conduit (RSC).
- C. This section specifies the following raceways:
 - 1. Raceways installed within buildings.
 - 2. Raceways installed outside building.
- D. Types of electrical boxes and fittings specified in this section include the following.
 - 1. Outlet boxes.
 - 2. Junction boxes.
 - 3. Pull boxes.
 - 4. Bushings.
 - 5. Locknuts.
 - 6. Knockout closures.

1.2 SUBMITTALS

- A. Product Data: For surface raceways and fittings.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required.
- B. Manufacturers: Firms regularly engaged in manufacture of electrical boxes and fittings of types and sizes required.

1.4 CODES AND STANDARDS:

- A. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publications pertaining to raceways.

- B. UL Compliance and Labeling: Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems. Provide raceway products and components which have been UL listed and/or labeled.
 - 1. UL No. 1: Flexible Metal Conduit
 - 2. UL No. 6: Rigid Steel Conduit, Zinc Coated
 - 3. UL No. 6: Rigid Steel Conduit, Enameled
- C. NEC Compliance: Comply with NEC as applicable to construction and installation of raceway systems, electrical wiring boxes and fittings.
- D. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL listed and/or labeled.
- E. NEMA Compliance: Comply with applicable requirements of NEMA Stds/Pub No.'s OS1, OS2 and Pub 250 pertaining to outlet and device boxes, covers and box supports.
- F. ANSI Publications:
 - 1. C80.1 Rigid Steel Conduit, Zinc Coated
 - 2. C80.2 Rigid Steel Conduit, Enameled

2 PRODUCTS

2.1 CONDUIT

- A. General: Provide conduit and fittings of types, sizes and weights for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements, and comply with applicable portions of NEC for raceways.
- B. Electrical Plastic Conduit (PVC):
 - 1. Extra Heavy Wall Conduit: Schedule 80, 90 degrees C, constructed of polyvinyl chloride and conforming to NEMA TC-2, for direct burial, or concrete encased use, UL listed and in conformity with NEC Article 347.
 - 2. All vertical ells shall be heavy wall rigid steel conduit.
- C. PVC Conduit Fittings: NEMA TC-3, mate and match to conduit or tubing type and material.
- D. Rigid Steel Conduit (RSC): Low carbon malleable iron, cadmium plated or hot-dipped galvanized inside and outside, with threaded ends, minimum size $\frac{3}{4}$ inch. Threaded Fittings - alloy steel, galvanized.
- E. Liquidtight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit; construct of single strip, flexible, continuous, interlocked, and double-wrapped

steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC), 3/4-inch minimum size.

1. Manufacturers (or approved equal):
 - a. Sealtite Type "UA" Anaconda, Liguatite Type "LA"
 - b. Electri-Flex Co., International Metal Hose Co.
 - c. Universal Metal Hose Company "Sealflex-U".
 2. Fittings shall be Series "6000" as manufactured by (or approved equal):
 - a. Thomas & Betts
 - b. Crouse-Hinds
 - c. Electri-Flex.
 3. Where an external ground is required, fittings shall be Series "5200GR" or "5300GR."
 4. Special care shall be taken to be sure that conduit bending radius limitations are not exceeded.
- F. Expansion/Deflection Fittings: Watertight Type "XC" or Type "DX" with integral bonding jumper for rigid metal conduit permitting movement up to 3/4 inch in any direction and angular deflection up to 30 degrees from normal in all directions as manufactured by (or approved equal):
1. Crouse-Hinds.
 2. O-Z/Gedney.
 3. Appleton.
- G. Sealing Fittings or Bushings: Series "EYS", "EZD" or "EZX" (as applicable) as manufactured by (or approved equal):
1. Crouse-Hinds.
 2. Pyle National.
 3. Appleton.
- H. Thruwall Sealing Fittings: Type "WKS" as manufactured by (or approved equal):
1. O-Z/Gedney.
 2. Appleton.
 3. Crouse-Hinds.
- I. Fire-Seal Fittings: Type "CFSI" as manufactured by (or approved equal):
1. O-Z/Gedney.
 2. Appleton.
 3. Crouse-Hinds.
- J. Conduit Bushings:
1. Insulated: Type "B" or "SBT" (as applicable) as manufactured by (or approved equal):
 - a. O-Z/Gedney.
 - b. Steel City.
 - c. Myers.

2. Grounding: Type "BLG" as manufactured by (or approved equal):
 - a. O-Z/Gedney.
 - b. Thomas & Betts.
 - c. Myers.

K. Conduit Locknuts:

1. Case-hardened locknuts shall be equal to Series No. 140 by (or approved equal):
 - a. Thomas & Betts.
 - b. Midwest Electric.
 - c. O-Z/Gedney.

2.2 MISCELLANEOUS MATERIAL AND FITTINGS

A. Pulling in Wire: Provide 5/32 inch polyethylene rope.

B. Thread lubricant/sealant shall be Type "STL" as manufactured by (or approved equal):

1. Crouse-Hinds.
2. Greenlee Tool.
3. Ideal Industries.

C. When required on joints for heat producing elements (such as lighting fixtures), thread lubricant shall be Type "HTL" as manufactured by (or approved equal):

1. Crouse-Hinds.
2. Ideal Industries.
3. 3M Company.

D. Nest Back Spacers: Type "NG" by (or approved equal):

1. O-Z/Gedney.
2. Appleton.
3. Raco.

E. Conduit Bodies:

1. Provide galvanized cast-metal conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements.
2. Construct conduit bodies with threaded-conduit-entrance ends, removable covers, either cast or of galvanized steel, and corrosion-resistant screws.
3. Manufacturers: Subject to compliance with requirements, provide conduit bodies of one of the following (or approved equal):
 - a. Appleton Electric; Div. of Emerson Electric Co.
 - b. Crouse-Hinds Co.
 - c. Killark Electric Mfg. Co.

2.3 BOXES AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Interior Outlet Boxes (or approved equal):

1. Appleton Electric
2. Emerson Electric Co.
3. General Signal Co.
4. Harvey Hubbell Inc.
5. Midland-Ross Corp.
6. O-Z/Gedney
7. RACO Div.
8. Thomas & Betts Co.

C. Junction and Pull Boxes (or approved equal):

1. Appleton Electric
2. Arrow-Hart Div.
3. Emerson Electric Co.
4. General Signal Co.
5. O-Z/Gedney Co.
6. Spring City Electrical Mfg. Co.

D. Bushings, Lockout Closures and Locknuts (or approved equal):

1. AMP, Inc.
2. General Signal Co.
3. Harvey Hubbell Inc.
4. Midland-Ross Corp.
5. O-Z/Gedney Co.
6. RACO Div.
7. Thomas & Betts Co., Inc.

2.4 FABRICATED MATERIALS

A. Outlet Boxes: Provide galvanized coated flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations.

1. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides.
2. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment grounding.

B. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for

supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Contractor's code-compliance option.

- C. Device Boxes: Provide galvanized coated flat rolled sheet-steel non-gangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations.
 - 1. Construct device boxes for flush mounting with mounting holes, and with cable-size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices.
 - 2. Provide cable clamps and corrosion-resistant screws for fastening cable clamps, and for equipment type grounding.
 - 3. Where multi-device boxes are required, provide gangable boxes where more than one device is mounted together.
- D. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Contractor's code-compliance option.
- E. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, no knockouts, UL listed, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.
 - 1. Boxes larger than 12" in any dimension shall be provided with hinged cover.
 - 2. Provide steel barriers in boxes with feeder circuits of different voltages.
- F. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit insulated bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

3 EXECUTION

3.1 GENERAL

- A. All installation shall comply with the NEC and OSHA.

3.2 EXAMINATION

- A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways.
- B. Notify Contracting officer's representative in writing of conditions detrimental to proper completion of the work.

- C. Do not proceed with work until unsatisfactory conditions have been corrected.

3.3 INSTALLATION OF CONDUITS

- A. Install conduit concealed unless indicated otherwise on the Drawings. Maintain minimum distance of six (6") inches from parallel runs of flues, steam or hot water pipes.
- B. Use liquid-tight flexible metal conduit for connections to motors, transformers and other equipment subject to vibration and in areas subject to moisture.
- C. Use flexible metal conduit for connections to recessed and/or semi-recessed lighting fixtures.
- D. Space groups of conduits uniformly. For bends and offsets, use an approved hickey or bending machine.
- E. Cut all conduit with hacksaw or approved cutting machine and ream after threading to remove all burrs.
- F. Fasten conduit securely to outlets, junctions and pullboxes to ensure firm electrical contact.
 - 1. Join conduit with approved couplings.
 - 2. No running threads will be allowed.
 - 3. Install insulated bushings and double locknuts on threaded conduits entering or leaving sheet metal outlet, junction, or pull boxes, and cabinets.
 - 4. Install grounding bushings on all conduits entering an enclosure such as a motor control center from below where the conduit is not attached to the enclosure.
 - 5. Bond all bushings to ground bus using conductor the same size as the equipment grounding conductor in the conduit.
 - 6. Install compression type connectors with insulated throats on electrical metallic tubing entering or leaving sheet metal outlet, junction or pull boxes and cabinets.
- G. Avoid condensation pockets in installations. Keep conduit, fittings, and boxes free from foreign matter, before, during and after installation.
- H. Not more than one (1) exposed conduit shall be run down to an exposed wall switch or outlet box.
- I. Use expansion/deflection fittings where rigid metal conduits pass from existing building structures to additions on new foundations, every 200 feet linear run maximum, and where otherwise indicated on the Drawings.
- J. Use thruwall sealing fittings where conduits enter buildings or vaults below finished grade.

- K. Do not use aluminum conduit on this project.
- L. Support runs of metallic conduit at least every eight (8') feet.
- M. Install runs of conduit parallel or perpendicular to walls, structural members or intersections of vertical planes and ceilings. Provide right angle turns consisting of fittings or symmetrical bends.
- N. Support conduits within one (1') foot of all changes in direction. Supports shall include wall brackets, trapeze hangers, strap hangers or pipe straps secured to hollow masonry with toggle bolts, to brick and concrete with expansion bolts, to metal surfaces with machine screws and to wood with wood screws.
- O. The use of wooden plugs (inserted in masonry), tie wire or nails as fastening media is prohibited.
- P. Support conduit risers exposed in wire shafts at each floor level with approved U-clamp hangers.
- Q. Install empty conduit for future use as indicated on the Drawings. Conduit shall be complete with rope, junction and outlet boxes.
- R. Conduit shall not be supported from metal roof deck.
- S. Provide pitchpocket where conduit penetrates roof.
- T. Conduit shall not penetrate concrete bases designed for vibration isolation.
- U. Apply thread lubricant/sealant to joints of all conduit buried in earth or concrete encased.
- V. Install fire-seal fittings or UL classified foam sealant where conduits penetrate concrete floor slabs or masonry walls required to be fire rated.
- W. Use nest back spacers in conjunction with conduit spacers or clamp backs when additional spacing away from mounting surface is required.
- X. All conduits shall be installed as high as possible in the ceiling cavity. Coordinate all conduit installation with ductwork.
- Y. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.
- Z. Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split coupling, and plugs that have been specifically designed and manufactured for their particular application.
- AA. Use roughing-in dimensions of electrically operated unit furnished by supplier.

- BB. Set conduit and boxes for connection to units only after receiving review of dimensions and after checking location with other trades.
- CC. Test conduits required to be installed, but left empty, with ball mandrel.
- DD. Clear any conduit which rejects ball mandrel.
- EE. Pay costs involved for restoration of conduit and surrounding surfaces to original condition.
- FF. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.
- GG. Field-bend conduit with benders designed for purpose so as not to distort or vary internal diameter.
- HH. Size conduits to meet NEC, except no conduit smaller than $\frac{3}{4}$ inch shall be installed.
- II. Fasten conduit terminations in sheet metal enclosures by 2 locknuts, and terminate with insulated bushing. Install locknuts inside and outside of enclosure.
- JJ. Conduits are not to cross pipe shafts or ventilating duct openings.
- KK. Support riser conduit at each floor level with clamp hangers.
- LL. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.
- MM. Complete installation of electrical raceways before starting installation of cables/wires within raceways.
- NN. Support exposed conduit by use of hangers, clamps or clips.
 1. Support conduit within 3'-0" of each outlet box, junction box, cabinet or fitting and on each side of bends and on spacing not to exceed following:
Rigid metal conduits up to 1": 6'-0"; 1-1/4" and over: 8'-0"; EMT up to 1": 5'-0"; 1-1/4" and over: 8'-0".
 2. Arrange conduit supports to prevent distortion of alignment by wire pulling operations.
 3. Fasten conduit using galvanized straps, caddy clamps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
 4. Requirements for exposed conduits also apply to conduits installed in space above hung ceilings.
- OO. Exposed Conduits:

1. Install conduits as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls.
2. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.
3. Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets.
4. Run conduits for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.
5. Requirements for exposed conduit also apply to conduits installed in space above hung ceilings.
6. Paint exposed exterior conduit to match adjacent surfaces.

PP. Conduit Fittings:

1. Construct locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.
2. Install insulated type bushings for terminating conduits. Bushings are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.
3. Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split coupling, and plugs to be specifically designed for their particular application.

QQ. Install expansion fittings in all raceways wherever structural expansion joints are crossed.

RR. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer.

SS. Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported.

TT. Use boxes as supplied by raceway manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc. shall not be permitted for use with surface raceway installations.

UU. Arrange conduit to maintain headroom and present a neat appearance.

VV. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

WW. Group conduits in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25% additional conduit.

XX. Do not fasten and/or hang conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.

- YY. Bring conduit to the shoulder of fittings and couplings and fasten securely. Raceways shall be cut to proper length so ends fit accurately in outlets.
- ZZ. Use conduit hubs for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.
- AAA. Install no more than the equivalent of three (3) 90 degree bends between boxes.
- BBB. Use conduit bodies to make sharp changes in direction, as around beams.
- CCC. Use hydraulic one-shot conduit bender for bends in conduit smaller than 2" size, or factory elbows for bends in conduit 2" and larger. Bends in metallic conduit shall be made while "cold."
- DDD. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- EEE. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- FFF. Where conduit penetrates fire rated walls, provide pipe sleeve two sizes larger than conduit; seal opening around conduit with UL listed foamed silicone elastomer compound.
- GGG. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket.
- HHH. Combining of circuits other than as indicated on the Drawings shall not be permitted.
- III. Bolts, clamps, screws and expansion bolts shall be used in securing conduit, equipment, etc. Holes for lead shields shall be drilled in solid brick or concrete and must be neatly cemented after bolts are in place.

3.4 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

- A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, OSHA, and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.
- D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

- E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

- F. Avoid installing boxes back-to-back in walls. Where receptacles are shown back-to-back in walls, they shall be mounted in separate boxes, a minimum of 6" apart (24" in acoustic rated walls) and connected together using flex with ground wire. Flex will not be acceptable for system grounding. The flex shall have a loop for limiting sound transmissions. Outlet boxes shall be equipped with plaster rings of appropriate depth to finish flush with finished wall. Outlets in exposed masonry walls shall be equipped with extra deep square corner tile rings so that boxes may be installed in brick walls or in the core of the block.
- G. Aluminum products shall not be installed.
- H. Position recessed outlet boxes accurately to allow for surface finish thickness.
- I. Do not use round boxes unless noted otherwise on the Drawings.
- J. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Boxes shall be supported independently of conduit.
- K. Provide electrical connections for installed boxes.
- L. Electrical box locations indicated on the Drawings are approximate unless dimensioned. Verify location of outlets prior to rough-in. Outlet may be relocated by the Contracting Officer or authorized representative at no additional cost.
- M. Locate and install to maintain headroom and to present a neat appearance.
- N. Use multiple gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- O. Install boxes in walls without damaging wall insulation.
- P. Position outlets to locate luminaries as indicated on the Drawings.
- Q. Align wall mounted outlet boxes for switches, thermostats, and similar devices.
- R. Subsequent to installation of boxes, protect boxes from construction debris and damage.
- S. Support all outlet boxes as required by the NEC. Suspended outlet boxes shall be independently supported from raceway by means of 1/4" all thread rod to structure.
- T. All outlet boxes or plaster rings shall finish flush with finished wall or ceiling. Outlets which do not finish flush (recessed) shall be equipped with copper tube stand-off nipples of proper length to hold wiring device securely in place. Wiring device shall be secure and shall not push in or rock.

3.5 GROUNDING

- A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements of Section 16060 – GROUNDING AND BONDING.

3.6 JUNCTION AND OUTLET BOX IDENTIFICATION:

- A. Identify each junction and outlet box cover with color and the type system that is within the box. Sample identifications are as follows:
- B. Fire Alarm (Red): Name "FIRE ALARM".
- C. The written labels above shall be neatly and legibly marked on the outside of the box covers using a permanent black ink marker.

END OF SECTION 16130

SECTION 16140

WIRING DEVICES

1 - GENERAL

1.1 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.

1.2 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

1.3 SUBMITTALS

- A. Product Data: For each product specified.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

1.5 COORDINATION

- A. Receptacles for Government-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Wiring Devices (or approved equal):
 - a. Bryant Electric, Inc.
 - b. Eagle Electric Manufacturing Co., Inc.
 - c. GE Company; GE Wiring Devices.
 - d. Hubbell, Inc.; Wiring Devices Div.
 - e. Killark Electric Manufacturing Co.
 - f. Leviton Manufacturing Co., Inc.

- g. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 RECEPTACLES

- A. Provide NEMA configuration 5-20R duplex 125 Volt grounding type receptacles rated for 20 Amperes unless otherwise indicated on the Drawings.
- B. Receptacles shall be specification grade, Bryant "5362" series, Hubbell "5352" series, P&S "5362" series, G.E., "5362" series, Sylvania "5362" series or Slater "5362" series (or approved equal).

2.3 OTHER RECEPTACLES

- A. Receptacles requiring a current or voltage rating or configuration different from duplex convenience receptacles shall be as indicated on the Drawings.
- B. Provide other receptacles with quality, material and workmanship at least equal to that specified for duplex convenience receptacles.
- C. Ground fault interrupter receptacles shall have the following features:
 - 1. UL listed: UL 943 Class A
 - 2. Configuration: Duplex, NEMA 5-20R
 - 3. Trip Current: 5 plus or minus 1 milliampere
 - 4. Trip Speed: 0.025 second maximum
 - a. Front-accessible test and reset pushbuttons
 - b. Manufacturer and type (or approved equal):
 - 1) Harvey Hubbell, Inc.: GP5362
 - 2) Pass & Seymour, Inc.: 2091
 - 3) Slater: SIR-20-F

2.4 SWITCHES

- A. Provide totally enclosed, 20 Ampere, 120/277 Volt, quiet AC general-use snap switches.
- B. Switches shall be single pole, double pole, three-way, four-way, locking or with pilot light as indicated on the drawings.
- C. Switches shall be specification grade, Bryant "4900" series, Hubbell "1220" series, P & S "20AC" series, G.E. "5950" series, Sylvania "1221A" series or Slater "720" series (or approved equal).

2.5 WALL PLATES

- A. Normal Power: Provide plates possessing the following additional construction features:
 - 1. Material and Finish: Stainless Steel.

- B. Wallplates: Provide wallplates for single and combination wiring devices, of types, sizes, and with ganging and cutouts as indicated.
 - 1. Sectional wallplates shall not be used. Select plates which mate and match wiring devices to which attached.
 - 2. Construct with metal screws for securing plates to devices; stainless screw heads to match finish of plates; wallplates shall be stainless steel.

2.6 FINISHES

- A. Color: Ivory, unless otherwise indicated or required by Code.

3 - EXECUTION

3.1 INSTALLATION

- A. All work shall be in accordance with NEC and OSHA requirements.
- B. Install devices and assemblies plumb and secure.
- C. Install wall plates when painting is complete.
- D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- E. Protect devices and assemblies during painting.
- F. Where adjacent to doors, coordinate with architectural drawings to ensure switches are installed on strike side of door.
- G. Locate switches approximately 48 inches (centerline) above finished floor elevation unless otherwise indicated.
- H. Locate receptacles approximately 18 inches (centerline) above finished floor elevation unless otherwise indicated.
- I. Install wiring devices only in electrical boxes which are clean (free from excess building materials, dirt, and debris).
- J. Install galvanized steel wallplates in unfinished spaces.

3.2 IDENTIFICATION

- A. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
- B. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

- A. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- B. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Use Hubbel model HBL5200 or equal.
- B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.5 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140

SECTION 16182

FUSES, MEDIUM AND HIGH VOLTAGE

1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. References: NEMA/ANSI/IEEE Publications:
 - 1. ANSI Standard C37.40-3.1-1981 General Purpose Current Limiting Power fuses.
 - 2. ANSI Standard C37.40-3.2/11-1981 Temperature Rise Criteria.
 - 3. ANSI Standard C37.46 Specifications for Power Fuses and Fuse Disconnecting Switches.
 - 4. NEMA Publication SG 2 High Voltage Fuses.

1.2 QUALITY ASSURANCE

- A. All medium and high voltage fuses shall be by the same manufacturer.
- B. Fuses shall have characteristics to ensure retention of selective coordination.

2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide fuses of one of the following (or approved equal):
 - 1. General Electric
 - 2. Kearney
 - 3. McGraw-Edison
 - 4. S & C

2.2 MANUFACTURED FUSES, MEDIUM AND HIGH VOLTAGE

- A. Medium and high voltage fuses shall have the features listed below:
- B. Medium voltage fuses, 2.5 to 450 amperes for transformer protection:
 - 1. Interrupting Rating: 50,000 amperes RMS symmetrical.
 - 2. Peak let-through current and let-through energy less than UL criteria.
- C. Manufacturer and Type (or approved equal):

1. G.E. EJO-1, Type "9F62," 5.5 kV maximum.
2. Kearney Type "B," 8.3 kV maximum.
3. McGraw-Edison Type "NX," 8.3, 15 or 22 kV maximum.
4. S&C Type "XS", 14.4 kV maximum.

3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses as indicted on the Drawings.
- B. Install fuses only after equipment installation is complete.
- C. At each point of application where fuses are used as overcurrent and/or short circuit protection, fuse all ungrounded conductors.

END OF SECTION 16182

SECTION 16350

MEDIUM-VOLTAGE TRANSFORMERS

1 - GENERAL

1.1 SUMMARY

- A. This Section includes distribution and power transformers with medium-voltage primaries.

1.3 SUBMITTALS

- A. Product Data: Include data on features, components, ratings, wiring diagram and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.
- B. Product Certificates: Signed by manufacturers of transformers certifying that the products furnished comply with requirements.
- C. Factory Test Reports: Certified copies of manufacturer's design and routine factory tests required by referenced standards.

1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide transformers specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with IEEE C2.
- C. Comply with NFPA 70.

2 - PRODUCTS

2.1 TRANSFORMERS, GENERAL

- A. Description: 2-winding type, designed for operation with high-voltage windings connected to a 3-phase, 3-wire, 60-Hz, from a grounded-neutral distribution system.
- B. Transformer shall be 112.5kVA 12,470V, 60 Hz, primary, 480Y/277V, 3 phase, secondary with all copper windings and terminals.

2.2 LIQUID-FILLED/PAD-MOUNTED TRANSFORMERS

- A. Description: Comply with IEEE C57.12.22 and ANSI C57.12.28.
- B. Description: Comply with IEEE C57.12.26 and ANSI C57.12.28.

- C. Insulating Liquid: Mineral oil, complying with ASTM D 3487, Type II, tested according to ASTM D 117.
- C. Full-Capacity Voltage Taps: Four 2.5-percent taps; 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use and with a position indicator and padlock hasp.
- E. High-Voltage Switching: Arranged for loop feed with 3-phase, 2-position, gang-operated load-break switch that is oil immersed in transformer tank with hook-stick operating handle in primary compartment.
- F. Primary Fuse: Current-limiting type in dry-fuse holder wells, mechanically interlocked with a liquid-immersed switch in the transformer tank to prevent disconnect under load.
- G. Surge Arresters: Distribution class, one for each primary phase. Comply with NEMA LA 1. Support from tank wall within high-voltage compartment.
- H. High-Voltage Terminations and Equipment: Dead front with universal-type bushing wells for dead-front bushing-well inserts. Include the following:
 - 1. Bushing-Well Inserts: One for each high-voltage bushing well.
 - 2. Surge Arresters: Dead-front, elbow-type, metal-oxide-varistor units.
 - 3. Parking Stands: One for each high-voltage bushing well.
 - 4. Portable Insulated Bushings: Arranged for parking insulated, high-voltage, load-break cable terminators; one for each primary feeder conductor terminating at transformer.
- I. Include the following accessories:
 - 1. Drain Valve: 1 inch (25 mm), with sampling device.
 - 2. Dial-type thermometer.
 - 3. Liquid-level gage.
 - 4. Pressure-vacuum gage.
 - 5. Pressure-Relief Device: Self-sealing with an indicator.
 - 6. Mounting provisions for low-voltage current transformers.
 - 7. Mounting provisions for low-voltage potential transformers.
- J. Watt Hour Meter: Watt hour demand meter for 3 phase, 4 wire service with CT's and PT's as required. Watt hour demand meter shall be on transformer 480/277 volt secondary.

2.3 FINISHES

- A. Enclosure Coating System for Outdoor Units: Comply with ANSI C57.12.28 regardless of transformer type. Transformer shall be painted with Fed # 20040 Dark Bronze.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Design and routine tests comply with referenced standards.

3 - EXECUTION

3.1 INSTALLATION

- A. Comply with IEEE C2.
- B. Identify transformers and install warning signs according to Division 16 Section "Basic Electrical Materials and Methods."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.2 GROUNDING

- A. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping as indicated to comply with NFPA 70.
- B. Comply with Division 16 Section "Grounding" for materials and installation requirements.

3.3 FIELD QUALITY CONTROL

- A. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers for dry-type transformers.
- B. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.

3.4 CLEANING

- A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.5 ADJUSTING

- A. After installing and cleaning, touch up scratches and mars on finish to match original finish.
- B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings with manufacturer recommended field test results.

END OF SECTION 16350

SECTION 16442

PANELBOARDS

1 - GENERAL

1.1 SUMMARY

- A. Extent of panelboard, load-center and enclosure work, including cabinets and cutout boxes is indicated by the Drawings and Schedules.
- B. Types of panelboard and enclosures required for the project include the following:
 - 1. Lighting and appliance panelboards.
- C. Refer to other Division 16 sections for wires/cables, electrical boxes and fittings, and raceway work required in conjunction with installation of panelboards and enclosures.
- D. Wire/cables, electrical boxes and fittings, and raceways required in conjunction with the installation of panelboards and enclosures are specified in other Division 16 sections.

1.2 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of panelboards and enclosures, of types, sizes, and ratings required, whose products are UL listed and/or labeled for the purpose intended.
- B. Electrical Code Compliance: Comply with applicable State code requirements of the authority having jurisdiction and NEC Article 384 as applicable to installation and construction of electrical panelboards and enclosures.
- C. UL Compliance: Comply with applicable requirements of Std No. 67, "Electric Panelboards," and Stds No.'s 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures. Provide units which are UL listed and/or labeled.
- D. Special-Use Markings: Provide panelboards, constructed for special-use, with appropriate UL marks which indicates that they are suitable for special type of use/application including service entrance equipment.
- E. NEMA Compliance: Comply with NEMA Stds Pub/No. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)," Pub/No. PB 1, "Panelboards," and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 volts or Less."

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's data on panelboards and enclosures.
- B. Shop Drawings: Submit layout drawings of panelboards showing accurately scaled basic equipment sections, auxiliary compartments and combination sections. In addition, show special relationships of units to associated equipment.

2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide panelboard products of one of the following (for each type and rating of panelboard and enclosure) (or approved equal):
 - 1. Cutler-Hammer/Westinghouse
 - 2. General Electric Company.
 - 3. Square D Company.

2.2 PANELBOARDS

- A. General: Except as otherwise indicated, provide panelboards, bolt-on breakers, integral common trip, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.
- B. Lighting and Appliance Panelboards: Provide factory assembled, dead front safety constructed, lighting and appliance panelboards circuit breaker type, in sizes and ratings indicated, with panelboard switching and protective devices in quantities, ratings, types, characteristics and with arrangement indicated; with anti-turn solderless pressure type main lug connections approved for use with copper conductors.
 - 1. Construct with rectangular shaped bus bars (Phase, neutral and ground) of solid copper, with conductivity not less than 98%, which are securely mounted and braced, and with solderless lugs bolted to main bus bars, and with full sized neutral bus and bare uninsulated ground bus suitable for bolting to enclosures, suitable for service with 480Y/277 volt, 3 phase, 4 wire, and 208Y/120 volt, 3 phase, 4 wire system.
 - 2. Provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections.
 - 3. Provide molded case main and branch circuit bolt-on breaker types for each circuit, with toggle handles that indicate when tripped.
 - 4. Branch circuit breakers for lighting circuits shall be Type "SWD"; for air conditioning and appliance circuits, Type "HACR."
 - 5. Where multiple pole breakers are indicated, provide with integral common trip so overload on one pole will trip all poles simultaneously.

6. Minimum integrated short circuit rating for branch circuit breakers shall be as noted on the Drawings.
 7. Select enclosures as noted on drawings fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.
- C. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with no knockouts and code sized wiring gutters.
1. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated.
 2. Equip with interior circuit-directory frame, and card with clear plastic covering.
 3. Provide baked gray enamel finish over a rust inhibitor coating.
 4. Design enclosures for recessed or surface mounting, as indicated on drawings.
 5. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed.
- D. Molded Case Circuit Breakers: Provide factory assembled, molded case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated.
1. Select breakers with permanent thermal and instantaneous magnetic trip, and with fault current limiting protection, ampere ratings as indicated.
 2. Construct with overcenter, trip free, toggle type operating mechanisms with quick-make, quick-break action and positive handle trip indication.
 3. Construct breakers for mounting and operating in any physical position, and operating in an ambient temperature of 40° C.
 4. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.
 5. Breaker terminals shall be approved for conductors rated 60/75° C, and shall be identified accordingly on each breaker.
- E. Panelboard Accessories: Provide panelboard accessories and devices including, but not necessarily limited to, cartridge and plug time-delay type fuses, circuit-breakers, ground-fault protection units, etc., as recommended by panelboard manufacturer for ratings and applications indicated.
- F. Short Circuit Rating: see panel schedules on Drawings for AIC ratings.
- G. Series rated panelboards are permitted provided all NEC and UL requirements are satisfied, and series rating data is submitted to the Contracting Officer or authorized representative.
- H. All main breakers shall be individually vertical mounted.

3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which panelboards and enclosures are to be installed, and notify Contracting Officer or authorized representative in writing of conditions detrimental to proper completion of work.
- B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PANELBOARDS

- A. General: Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards, OSHA, and NECA's "Standard of Installation," and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.
- C. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.
- D. Provide properly wired electrical connections for panelboards within enclosures.
- E. Fill out panelboard's circuit directory card with typewriter upon completion of installation work.
- F. All neutral and ground wires shall have taped on numbers at panels indicating circuits served.
- G. Install panelboards approximately 6 feet 6 inches (top) above finished floor elevation unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

- A. Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.
- B. Prior to energization, check panelboards for electrical continuity of circuits, and for short-circuits.

3.4 GROUNDING

- A. Provide equipment grounding connections for panelboards as indicated.

- B. Tighten connections to comply with tightening torques specified in UL Stds 486A to assure permanent and effective grounds.
- C. Upon completion of installation work, properly ground panelboards and demonstrate compliance with requirements of Section 16060 – GROUNDING AND BONDING.

3.5 ADJUSTING AND CLEANING

- A. Adjust operating mechanisms for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finishes.

3.6 DEMONSTRATION

- A. Subsequent to wire and cable hookups, energize panelboards and demonstrate functioning in accordance with requirements.
- B. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 16442

SECTION 16460

LOW VOLTAGE TRANSFORMERS

1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. Extent of transformer work is indicated by drawings.
- B. Types of transformers specified in this section include the following:
 - 1. Dry-type transformers.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data including rated kVA, frequency, primary and secondary voltages, percent taps, polarity, impedance and certification of transformer performance efficiency at indicated loads, percentage regulation at 100% and 80% power factor, no-load and full-load losses in watts, % impedance at 75° C, hot-spot and average temperature rise above 40° C ambient temperature, sound level in decibels, and standard published data.
- B. Shop Drawings: Submit manufacturer's drawings indicating dimensions, and weight loading for transformer installations, showing layouts, wall bracket mountings and supports, spatial relationship to panelboards and associated equipment, include transformer connections to electrical equipment.
- C. Wiring Diagrams: Submit wiring diagrams for transformers showing connections to electrical power feeders and distribution branches. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed.
- D. Maintenance data for materials and products for inclusion in Operating and Maintenance Manual.

1.4 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of transformers of types and ratings required, whose products are UL listed and labeled.
- B. NEC Compliance: Comply with NEC as applicable to installation and construction of electrical dry- type transformers.

- C. NEMA Compliance: Comply with requirements of NEMA Std Pub/No.'s ST 20; "Dry-Type Transformers for General Applications," TR 1, and TR 27.
- D. ANSI Compliance: Comply with applicable requirements of ANSI Standards C57-Series pertaining to power/distribution transformers.
- E. UL Compliance: Comply with applicable requirements of ANSI/UL 506; "Safety Standard for Specialty Transformers." Provide dry-type transformers and components which are UL listed and labeled.
- F. NESC Compliance: Comply with applicable requirements of National Electrical Safety Code (ANSI Std C2) pertaining to indoor and outdoor installation of transformers.

2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (or approved equal):
 1. General Electric Company.
 2. Hevi-Duty Electric Div.; General Signal Corp.
 3. Square D Company.

2.2 TRANSFORMERS

- A. General: Except as otherwise indicated, provide manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by manufacturer, and as required for complete installation.
- B. Dry-Type Distribution Transformers: Provide factory-assembled, general-purpose, ventilated, dry-type distribution transformer where shown; of sizes, characteristics, and ratings as indicated on the Drawings, 3-phase, 60-Hz, 1.8% impedance minimum; with 480 volt delta-connected, 10 kV BIL primaries; and 208Y/120 volt, 4 wire wye-connected, with grounded neutral.
 1. Provide primary windings with 6 taps; 2, 2-1/2% increments above full-rated voltage and 4, 2-1/2% increments below full-rated voltage for de-energized tap-changing operation.
 2. Insulate with Class 220 insulation, with a maximum allowable temperature rise of 80° C.
 3. Rate transformer for continuous operation at rated kVA; limit transformer surface temperature rise to maximum of 65 degrees C.
 4. Provide terminal enclosure, with hinged cover, to accommodate primary and secondary coil wiring connections and electrical supply raceway terminal connector.
 5. Provide terminal board with clamp type connectors.

6. Limit terminal compartment temperature to 75° C when transformer is operating continuously at rated load with ambient temperature of 40° C.
7. Provide wiring connections suitable for copper wiring.
8. Integrally mount vibration isolation supports between core and coil assembly and transformer enclosure; electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap.
9. Do not exceed maximum sound-level rating of 50 db as determined in accordance with ANSI/NEMA standards.
10. Provide transformers with fully-enclosed weather-resistant steel enclosures, and lifting lugs.
11. Apply manufacturer's standard light gray outdoor enamel over cleaned and phosphatized steel enclosure.
12. Provide transformer suitable for floor mounting as indicated on the Drawings.

3 - EXECUTION

3.1 TESTING

- A. Prior to energization of transformer, check all accessible connections for compliance with manufacturer's torque tightening specifications.
- B. Prior to energization, check circuitry for electrical continuity, and for short-circuits.

3.2 INSPECTION

- A. Installer must examine area and conditions under which transformer and ancillary equipment are to be installed, and notify Contracting Officer or authorized representative in writing of conditions detrimental to proper completion of the work.
- B. Do not proceed with the work until satisfactory conditions have been corrected.

3.3 INSTALLATION OF TRANSFORMERS

- A. Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NESC, NEMA, ANSI and IEEE standards, and in accordance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate transformer installation work with electrical raceway and wire/cable work, as necessary for proper interface.
- C. Install units on vibration mounts; comply with manufacturer's indicated installation method, if any.
- D. Connect transformer units to electrical wiring system with liquidtight flexible conduit; comply with requirements of other Division 16 sections.

- E. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A and B.

3.4 GROUNDING

- A. Provide equipment grounding connections for transformers as indicated, including Ground connection to water pipe and ground connection to grounding rod.
- B. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounding.
- C. Upon completion of installation work, properly ground transformers and demonstrate compliance with requirements of Section 16060 – GROUNDING & BONDING.

END OF SECTION 16460

SECTION 16515

INTERIOR LIGHTING FIXTURES

1 - GENERAL

1.1 SUMMARY

- A. Extent, location, and details of interior lighting fixture work are indicated on drawings.
- B. Types of interior lighting fixtures in this section include the following:
 - 1. Fluorescent.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions on each type of interior lighting fixture and component.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of interior lighting fixtures of sizes, types and ratings required, whose products are UL listed and/or labeled.
- B. Codes and Standards:
 - 1. Electrical Code Compliance: Comply with applicable State code requirements of the authority having jurisdiction and NEC Articles 220, 410, and 510 as applicable to installation, and construction of interior building lighting fixtures.
 - 2. NEMA Compliance: Comply with applicable requirements of NEMA Stds Pub/No.'s LE 1 and LE 2 pertaining to lighting equipment.
 - 3. UL Compliance: Comply with UL standards, including UL 486A and B, pertaining to interior lighting fixtures. Provide interior lighting fixtures and components which are UL listed and labeled.
 - 4. CBM Labels: Provide electronic fluorescent lamp ballasts which comply with Certified Ballast Manufacturers Association standards and carry the CBM label.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver interior lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from damage.
- B. Store interior lighting fixtures in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.

- C. Handle interior lighting fixtures carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of interior lighting fixtures with other work.
- B. Sequence interior lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide interior lighting units of one of the following (for each type of interior lighting unit) (or approved equal):
 - 1. General Electric Co.
 - 2. Hubbell
 - 3. Holophane Div; Johns-Manville Corp.
 - 4. Lithonia
 - 5. Daybrite
- B. Fluorescent Ballasts:
 - 1. Advance Transformer Co.
 - 2. Electronic Ballast Technology
 - 3. Magnatek
 - 4. Osvam
- C. Lamps
 - 1. General Electric
 - 2. Osvam-Sylvania
 - 3. Phillips

2.2 INTERIOR LIGHTING FIXTURES

- A. General: Provide lighting fixtures, of sizes, types and ratings indicated; complete with, but not limited to, housings, energy efficient ballasts, starters, wiring, poles and standards.
- B. Wiring: Provide electrical wiring within fixture suitable for connecting to branch circuit wiring.

- C. Fluorescent Lamp Ballasts: Provide solid state low-temperature, high power-factor, Class P, UL Listed integrated electronic ballasts, capable of operating lamp types indicated.
 - 1. Ballasts shall be Electronic Integrated Circuit type.
 - a. Ballast sound levels shall not exceed Class A ambient noise levels.
 - b. Ballast shall maintain constant light output of all rapid start fluorescent lamps over operating ranges of 90V to 145V (120V ballasts) and 200V to 320V (277V ballasts).
 - c. Input current Total Harmonic Distortion content shall be below 15 percent (expressed in percentage of full light output current level).
 - d. Ballast shall have an average lamp current crest factor below 1.4.
 - e. Where applicable, ballasts shall meet minimum efficacy standards of Public Law No. 100-357, National Appliance Energy Conservation Amendments of 1988.
 - f. Ballast shall be rapid startup.
 - g. Ballast shall withstand line transients as defined in ANSI/IEEE C62.41, Category A.
 - h. Ballast case temperature shall not exceed 25° C temperature rise over 40° C ambient.
 - i. Ballast shall have a frequency of operation of 20 kHz or greater, and operate without visible flicker.
 - j. Ballast shall have a power factor of 90% or above.
 - k. Ballast shall not contain polychlorinated biphenyls (PCB's).
 - l. Ballast shall meet the requirements of the Federal Communications Commission Rules and Regulations, Part 18, Class A.

- D. Interior Lighting Fixture Types:
 - 1. General: Fixtures must comply with minimum requirements as stated herein. Review architectural drawings and specifications to verify ceiling types, modules, suspension systems appropriate to installation.

3- EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which lighting fixtures are to be installed, and substrate for supporting lighting fixtures.
- B. Notify Contracting officer's representative in writing of conditions detrimental to proper completion of the work.
- C. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF INTERIOR LIGHTING FIXTURES

- A. Install interior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, OSHA, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Provide fixtures and/or fixture outlet boxes with hangers to properly support fixture weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by Contracting officer's representative.
- C. Fasten fixtures securely to indicated structural supports; and ensure that pendant fixtures are plumb and level. Provide individually mounted pendant fixtures longer than two (2') feet with twin stem hangers. Provide stem hanger with ball aligners and provisions for minimum one (1") inch vertical adjustment.
- D. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B, and the National Electrical Code.
- E. Support surface mounted fixtures greater than two (2') feet in length at one other point in addition to the outlet box fixture stud.
- F. Surface mounted fluorescent fixtures shall be mounted using 1/4" threaded rod at each end and rods shall be attached to the building structure above the ceiling. Ceiling grid tees shall not be used for supporting surface mounted fixtures.

3.3 FIELD QUALITY CONTROL

- A. Replace defective and burned out lamps for a period of one year following the Date of Substantial Completion.
- B. At Date of Substantial Completion, replace lamps in interior lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing, as judged by Contracting officer's representative.

3.4 GROUNDING

- A. Provide equipment grounding connections for interior lighting fixtures as indicated and as specified in Section 16060 – GROUNDING AND BONDING.
- B. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

3.5 ADJUSTING AND CLEANING

- A. Clean interior lighting fixtures of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses.
- B. Protect installed fixtures from damage during remainder of construction period.

3.6 DEMONSTRATION

- A. Upon completion of installation of interior lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements.
- B. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION 16515

SECTION 16721

FIRE DETECTION, ALARM AND RADIO TYPE REPORTING SYSTEM

1 GENERAL: This specification outlines requirements for modifications of the existing fire alarm monitoring and control equipment for Buildings 3420 and 3422 at Seymour Johnson Air Force Base at Goldsboro, North Carolina.

1.1 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. All publications shall be referred to in their latest edition, including any revisions thereof.

1. American National Standards Institute(ANSI)

ANSI C62.41	Recommended Practice for Surge Voltage in Low-Voltage AC Power Circuits
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2. National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm Code
NFPA 78	Lightning Protection Code
NFPA 90A	Installation of Air Conditioning and Ventilation Systems

3. Underwriters Laboratories, Inc. (UL)

UL Directory	Fire Protection Equipment Directory
UL 06	Rigid Metal Conduit
UL 38	Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
UL 268	Smoke Detectors for Fire Protective Signaling Systems
UL 268A	Smoke Detectors for Duct Application
UL 464	Audible Signal Appliances
UL 521	Heat Detectors for Fire Protective Signaling Systems

UL 797 Electrical Metallic Tubing

UL 864 Control Units for Fire Protective Signaling Systems

- B. All work and equipment shall comply with applicable OSHA requirements, and with all applicable FCC requirements.

1.2 GENERAL REQUIREMENTS

- A. Products: The Contractor shall provide a new fire alarm control panel with additional initiating devices and alarm indicating appliances to an existing low voltage, automatic integrated transceiver/fire alarm control panel. Panel shall have, as a minimum, the following:
 - 1. Hardware Features:
 - a. Eighty (80) character alphanumeric, super twist liquid crystal display.
 - b. Eight (8) indicating device circuits (IDCs), Style B, Class B.
 - c. Four (4) notification appliance circuits (NACs), Style Y, Class B.
 - d. Four (4) amp power supply/battery charger.
 - e. Power limited design.
 - f. Pluggable terminal blocks.
 - 2. Software Features:
 - a. Menu driven programming.
 - b. On-site programming custom labels.
 - c. Four operator access levels.
 - d. Historical event logs.
 - e. Circuit selectable alarm verification.
 - f. Walk test performance testing.
 - g. Selectable active status reminder.
 - 3. Additional Features:
 - a. Expansion modules as required.
 - b. Additional power supply as required.
 - 4. Certification:
 - a. UL, ULC listed.
 - b. FM approved.
 - 5. Manufacturers:
 - a. Simplex 4005 Series.
- B. Provide new initiating and notification devices as detailed in the specifications and as shown on the drawings.
- C. Reconnect existing Monaco transmitter as required.
- D. Reconnect existing initiating and notification devices as required.

- E. Reconnect existing 120 volt power as required.
- F. Any additional modules required are to be purchased and installed by certified personnel.
- G. Verification 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 or authorized representative of any discrepancy before performing the work.
- H. Compliance: The fire detection and internal alarm system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed or FM approved or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.
- I. Manufacturer's Services: Services of a manufacturer's representative who is certified in the installation, maintenance, adjustment, operation and repair, of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, programming, testing and certification of the equipment.
- J. Delivery and Storage: All equipment delivered and placed in storage shall be protected from the weather, humidity and temperature variations, dirt, dust, and other contaminants.
- K. Programming: Contractor is required to fully program the transceiver and the D-500 to communicate by zone and remote test.

1.3 SYSTEM DESIGN

- A. Operation: Existing fire alarm devices will remain and shall be wired to the new Fire Alarm Control Panel. New fire alarm devices will be added and system will continue to be a complete, supervised fire alarm system to maintain system integrity. The system is activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until any initiating device is reset and the fire alarm control panel is manually reset and restored to normal. Electrical supervision shall match existing and be in accordance with NFPA 72. All circuits shall be capable of operating under a single ground or open condition, as specified in NFPA 72. All textual, audible and visual devices and systems shall comply with NFPA 72.
- B. Operational Features. The existing system shall be modified to accommodate additional pull stations and alarm indicating devices as shown on drawing:
 - 1. Alarm initiating (zone) circuits for connection of detection devices shall match class of existing alarm initiating (zone) circuits.
 - 2. Auxiliary zone circuits for connection of non-powered alarm initiating devices such as tamper switches, heat detectors or manual pull stations.

3. Alarm indicating (bell) circuits for connection of audible and visual alarm evacuation signaling devices shall match class of existing alarm indicating circuits.
4. Zone programming capability which allows entry of a zone identification number, thirteen character description and type. Each zone is programmed for standard, supervisory, verification, positive alarm sequence, or water-flow warm operation; the auxiliary zones may also be programmed for tamper or for publicly accessible manual pull station.
5. Zones for alarm initiating circuits shall be arranged as indicated on the contract drawings.
6. Alarm functions. An alarm condition on a circuit shall automatically initiate the following functions:
 - a. Transmission of a signal (by zone and general alarm/general trouble) over the station fire reporting system.
 - b. Visual indication of the alarmed zone on the fire alarm control panel annunciator..
 - c. Continuous sounding of alarm indicating devices throughout the building.
 - d. Operation of the smoke control system.
 - e. Deactivation of the air handling, exhaust fans units throughout the building.

1.4 SUBMITTALS

- A. Installer Qualification. Installer must have five years experience in the installation of fire alarm systems and possess a minimum LEVEL II certificate from the NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET) in the sub-field FIRE PROTECTION ENGINEERING TECHNOLOGY (FIRE ALARM SYSTEMS). No fire alarm work is to be done with non-certified personnel (ie. electrician, helper, etc.)
- B. Shop Drawings. Shop drawings shall be submitted and shall consist of a complete set of equipment and materials, including manufacturer's descriptive and technical literature; performance charts and curves; catalog cuts; and installation instructions. Detail 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 anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.
- C. Test Reports. Upon completion and testing of the installed system, test reports

shall be submitted in booklet form showing all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

D. Operation and Maintenance Manuals.

1. The contractor shall furnish the Contracting Officer or authorized representative three complete copies of operating instructions outlining step-by-step procedures required for system start up, operation and shut down. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features.
2. The contractor shall furnish the Contracting Officer or authorized representative three 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 system installed.

E. Spare Parts Data. After approval of the shop drawings 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 supplied, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 3 years of service.

F. As Built Drawings. PRIOR TO PERFORMANCE AND ACCEPTANCE TESTING, The contractor shall submit two legible copies of all fire alarm drawings showing the "as-built" system. The detail drawings of the fire detection system shall be signed by a Fire Protection Engineer. The drawings shall consist of a complete list of equipment and material, including manufacturer's descriptive and technical literature and catalog cuts. The drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. The detailed point-to-point wiring diagram showing all points of connection shall include connections between system devices, appliances, control panels, supervised devices, and all equipment that is activated by the control panel.

G. Certificates of Completion. PRIOR TO PERFORMANCE AND ACCEPTANCE TESTING, a Certificate of Completion per NFPA 72 shall be given to the Contracting Officer or authorized representative. "NOTE" The individual signing the certificate is warranting that the fire alarm system has been installed per NFP, NEC, UL and Air Force specifications and codes.

1.5 OVER VOLTAGE 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 requirements of ANSI C62.41. Surge protector shall be a Delta LA 301 or equal.

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, any other contaminants.

2 - PRODUCTS

2.1. Manual Fire Alarm Stations:

- A. Manual fire alarm stations shall conform to the applicable requirements of the UL 38. Manual stations shall be connected into alarm initiating circuits. Stations shall be single action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a 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. Where boxes must be surface mounted, boxes shall be painted the same color as the fire alarm manual stations. All manual pull stations located in the public areas shall have clear shield protective tamper cover placed over them.

2.2 NOTIFICATION APPLIANCES

- A. Audible appliances shall be heavy duty and conform to the applicable requirements of UL 464. Devices shall be connected into alarm indicating circuits. All devices shall have separate screw terminals for each conductor.
- B. Combination Audible/Visual Notification Appliances. Combination audible/visual appliances shall be factory assembled. Units shall be suitable for use in an electrically supervised circuit and shall have a sound output rating of at least 85 dBA at 10 feet. Visual indication shall be accomplished by high intensity optic lens and flash tubes.

2.3 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

- A. Conduit shall comply with UL 06 and UL 797.
- B. Wiring. All wiring shall be copper. Wiring for strobe light circuits shall be No. 14 AWG minimum. Wiring for 120 v AC power shall be No. 12 AWG minimum. Wiring for power limited circuits shall be No. 14 AWG minimum/Power wiring and control wiring shall be isolated. All wiring shall conform to NFPA 70. All conductors shall be color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections are unacceptable.

3 - EXECUTION

3.1 INSTALLATION

- A. All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified.
- B. Wiring. Wiring for systems shall be installed in 1/2 inch minimum diameter conduit; however the wiring for the fire alarm system shall not be installed in conduits, junction boxes with conductors of lighting and power systems. No more than one conductor shall be installed under any screw terminal. All circuits conductors entered 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. The use of wire nut type connectors are prohibited in the system. 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 wiring to the control panel.
- C. Painting. All junction boxes shall be painted red.
- D. Notification Appliances. Devices shall be mounted 6 feet 8 inches above the finished floor elevation, or 6 inches below finished ceiling, if limited by ceiling height.
- E. Grounding. Grounding shall be provided to building ground.
- F. Manual Pull Stations shall be installed at approximately 4 feet (center) above finished floor elevation unless otherwise indicated.

3.2 TESTING

- A. The contractor shall notify the Contracting Officer or authorized representative 30 days before the performance and acceptance tests on new fire alarm devices are to be conducted. Existing fire alarm devices are not subject to testing. The Contractor shall provide battery calculations for the fire alarm system to the Contracting Officer or authorized representative 30 days prior to the acceptance test. The test shall be performed in the presence of the Contracting Officer or authorized representative under the supervision of the fire alarm system manufacturer's qualified representative. The contractor shall furnish all instruments, equipment 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 new initiating and notification appliance. Tests shall include the meggering of all system conductors to determine that the system is free from grounded, shorted and open circuits. The megger test shall be conducted prior to the installation of new 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 that 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 include

the following functions as applicable to the circuits modified or added:

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. Test of each alarm notification appliance.
6. Test of the battery charger and batteries.
7. Complete operational test under emergency power supply.
8. Visual inspection of all wiring connections.
9. Opening the circuit at each alarm initiating and indicating device to test the wiring supervisory feature.
10. Verification of the as-built drawings to insure that they are correct.

3.3 TRAINING

- A. The contractor shall arrange for systems vendor to conduct system/equipment operation training for new equipment. Training session shall be of 4 hours for each major system/subsystem. The contractor shall notify the Contracting Officer or authorized representative 30 days before the training session is to be conducted.

END OF SECTION 16721

SCHEDULE OF MATERIAL SUBMITTALS												PROJECT NUMBER VKAG 99-1159		PROJECT TITLE INSTALL FIRE SUPPRESSION, ATC STORAGE BLDGS 3420/3422			SOLICITATION/CONTRACT NUMBER			
TO BE COMPLETED BY PROJECT ENGINEER												TO BE COMPLETED BY CONTRACT ADMINISTRATOR								
LINE NUMBER	ITEM OR DESCRIPTION OF ITEM, CONTRACT REFERENCE, TYPE OF SUBMITTAL	NUMBER OF COPIES REQUIRED										DATE RECEIVED IN CONTRACTING	DATE TO CIVIL ENGINEERING	RETURN/SUSPENSE	SUBMITTAL NUMBERS	DATE CONTRACTOR NOTIFIED		CONTRACTOR RESUBMITTAL	FINAL APPROVAL	REMARKS
		CERTIFICATION OF COMPLIANCE	SHOP DRAWINGS	SAMPLES	COLOR SELECTION	MANUFACTURER'S RECOMMENDATIONS	MANUFACTURER'S WARRANTY	CATALOG DATA	OPERATING INSTRUCTIONS	OTHER	SUBMITTAL CODE					REQUIRED SUBMISSION DATE	APPROVED			
78	13921 PARA 1.2A PRESSURE MAINT. PUMP							3				A								
79	13921 PARA 1.2B WIRING DIAGRAM		3									A								
80	13921 PARA 1.2A FIRE PUMP CONTROLLER							3				A								
81	13921 PARA 1.2A PM PUMP CONTROLLER							3				A								
82	13921 PARA 1.2.C FIRE PUMP								3			A								
83	13921 PARA 1.2.C FIRE PUMP CONTROLLER								3			A								
84	13921 PARA 1.2.D FIRE PUMP							3				A								
85	13921 PARA 1.2.D FIRE PUMP CONTROLLER								3			A								
86	16060 PARA 3 GROUNDING & BONDING									3		A								
87	16120 PARA 1.2A CONDUCTORS & CABLES								3			A								
88	16124 PARA 2.2 MEDIUM VOLTAGE CABLE									3		A								

SCHEDULE OF MATERIAL SUBMITTALS													PROJECT NUMBER		PROJECT TITLE			SOLICITATION/CONTRACT NUMBER			
													VKAG 99-1159		INSTALL FIRE SUPPRESSION, ATC STORAGE BLDGS 3420/3422						
TO BE COMPLETED BY PROJECT ENGINEER													TO BE COMPLETED BY CONTRACT ADMINISTRATOR								
LINE NUMBER	ITEM OR DESCRIPTION OF ITEM, CONTRACT REFERENCE, TYPE OF SUBMITTAL	NUMBER OF COPIES REQUIRED											DATE RECEIVED IN CONTRACTING	DATE TO CIVIL ENGINEERING	RETURN/SUSPENSE	SUBMITTAL NUMBERS	DATE CONTRACTOR NOTIFIED		CONTRACTOR RESUBMITTAL	FINAL APPROVAL	REMARKS
		CERTIFICATION OF COMPLIANCE	SHOP DRAWINGS	SAMPLES	COLOR SELECTION	MANUFACTURER'S RECOMMENDATIONS	MANUFACTURER'S WARRANTY	CATALOG DATA	OPERATING INSTRUCTIONS	OTHER	SUBMITTAL CODE	REQUIRED SUBMISSION DATE					APPROVED	DISAPPROVED			
109	16721 PARA 1.4E FIRE DET., ALARM . . .	3									B										
110	16721 PARA 1.4F FIRE DET., ALARM . . .										3	A									
111	16721 PARA 1.4G FIRE DET., ALARM . . .	3										A									
112	DWG E2 POLE MTD 15KV FUSE CUTOUTS		3									A									
113	DWG E2 POLE MTD 15KV FUSE CUTOUTS							3				A									
114	DWG E2 POLE MTD FUSE LINK		3									A									
115	DWG E2 POLE MTD FUSE LINK							3				A									
116	DWG E2 POLE MTD ARRESTORS		3									A									
117	DWG E2 POLE MTD ARRESTORS							3				A									
118	DWG F2 DTL 4/F2 DOUBLE LEAF PIT DOOR							3				A									
119	DWG F2 DTL 7/F2 EXHAUST FAN							3				A									

