PROJECT MANUAL

VOLUME 2 of 2

EXCHANGE FOOD COURT/
FURNITURE STORE & MALL UPGRADES
MACDILL AIR FORCE BASE, FLORIDA
AAFES PN: 0926-16-000003

CONTRACTS: COMBINED WORK – ALL TRADES

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DATE: 18 MAY 2018
SOLICITATION SPECIFICATIONS
EXCHANGE FOOD COURT/
FURNITURE STORE & MALL UPGRADES
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EXCHANGE FOOD COURT/ FURNITURE STORE & MALL UPGRADES
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ARCHITECT: h. michael bohnsack ARCHITECTS

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All Sections of Division 1
Section 02070
Section 02282
All Sections of Division 3
All Sections of Division 4
All Sections of Division 5
All Sections of Division 6
All Sections of Division 7
All Sections of Division 8
All Sections of Division 9
All Sections of Division 10
All Sections of Division 11
Section 12690

SIGNATURE

CURRENT DATE 18 May 2018
LICENSE EXPIRATION DATE 30 Nov 2018

Drawing Sheets: T-Sheets, DCA-1.10, CA-Sheets, D-Sheets, SA-Sheets, A-Sheets, EQ-Sheets & FS-Sheets

ENVIRONMENTAL ENGINEER: Greenfield Environmental

Project Manual: Section 02083 w/Attachments

SIGNATURE

CURRENT DATE 18 May 2018
LICENSE EXPIRATION DATE 28 Feb 2019

Drawing Sheets: Attached to Section 02083
CIVIL ENGINEER: Mark B. Tyl, P.E.
Project Manual:  
- Section 02300
- Section 02740
- Section 02750
- Section 02923

SIGNATURE

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FIRE PROTECTION ENGINEER: SSC Engineering, Inc.
Project Manual: All Sections of Division 13

SIGNATURE

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Drawing Sheets: Sheet FAD-Sheets, All FA-Sheets, All FPD-Sheets, All FP-Sheets, All LS-Sheets
MECHANICAL ENGINEER: McCoy & Howard Consulting Engineers, Inc.
Project Manual: All Section of Division 15

ELECTRICAL ENGINEER: McCoy & Howard Consulting Engineers, Inc.
Project Manual: All Sections of Division 16
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1. GENERAL

1.1. REFERENCES

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

FM GLOBAL (FM)

FM APP GUIDE (updated online) Approval Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1221 (2016) Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems

NFPA 70 (2017) National Electrical Code


UNDERWRITERS LABORATORIES (UL)

UL 1242 (2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel

UL 1971 (2002; Reprint Oct 2008) Signaling Devices for the Hearing Impaired


UL 268A (2008; Reprint Oct 2014) Smoke Detectors for Duct Application


UL 464 (2016) Standard for Audible Signal Appliances

UL 6 (2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel

1.2. SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00:

SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings/Fire Alarm System; G

SD-03 Product Data

Storage Batteries; G
Low Battery Voltage; G
Special Tools and Spare Parts
Technical Product Data; G
Testing

SD-06 Test Reports

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SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G

1.3. QUALITY ASSURANCE

1.3.1. Qualifications

Submit proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

1.3.1.1. Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

1.3.1.2. Installer

The installing Contractor shall provide the following: Fire Alarm Technicians to perform the installation of the system. A Fire Alarm Technician with a minimum of 4 years of experience shall perform/supervise the installation of the fire alarm system. Fire Alarm Technicians with a minimum of 2 years of experience shall be utilized to assist in the installation and terminate
fire alarm devices, cabinets and panels. An electrician shall be allowed to install wire or cable and to install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.3.1.3. Fire Protection Engineer

Installations needing designs or modifications of fire detection, fire alarm, or fire suppression systems require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.

b. A registered professional engineer (P.E.) in fire protection engineering.

c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.

d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

1.3.2. Detail Drawings

Submit detail drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical audible appliances. Check the layout based on the actual audible devices to be installed and make any necessary revisions in the detail drawings. The detail 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. Detail drawings and detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

1.4. DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

1.5. SPECIAL TOOLS AND SPARE PARTS

Submit spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service. Furnish software, connecting cables, proprietary equipment and two spare fuses of each type and size required, necessary for the maintenance, testing, and reprogramming of the equipment. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Mount spare fuses in the fire alarm panel.

2. PRODUCTS

2.1. SYSTEM DESCRIPTION

The fire detection and alarm system and the central reporting system shall be a complete, supervised fire alarm reporting system configured in accordance with NFPA 72 and UFC 3-600-01.
exceptions are acceptable as directed by the Contracting Officer. Furnish equipment compatible and UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards. Locks shall be keyed alike. Provide four keys for the system. Furnish tags with stamped identification number for keys and locks.

2.1.1. Operation

Activate the system into the alarm mode by actuation of any alarm initiating device. The system will remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm and supervisory initiating devices shall be individually addressable. Alarm initiating devices shall be connected to signal line circuits (SLC), Class B, in accordance with NFPA 72. Connect alarm notification appliances to notification appliance circuits (NAC), Class B in accordance with NFPA 72. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc.

2.1.2. Operational Features

The system shall have the following operating features:

a. Monitor electrical supervision of IDC, SLC, and NAC.

b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.

c. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.

d. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices other than smoke detectors shall be programmed without confirmation or verification.

2.1.3. Alarm Functions

Sequence of operations shall match that of the existing system, or an alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of a signal over the station fire reporting system.

b. Visual indications of the alarmed devices on the fire alarm control panel display.

c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ASA S3.41.

d. Closure of doors held open by electromagnetic devices.

e. Deactivation of the air handling units throughout the building.

2.1.4. Primary Power
Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

2.1.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

2.1.6 Interface with Existing Fire Alarm Equipment

The equipment specified herein shall operate as an extension to an existing configuration. Submit certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards. The new equipment shall be connected to an existing control panel in the existing part of the building. Existing control equipment shall be expanded, modified, or supplemented as necessary to extend the existing control functions to the new points or zones. New components shall be capable of merging with the existing configuration without degrading the performance of either system. The scope of the acceptance tests of paragraph Testing shall include aspects of operation that involve combined use of both new and existing portions of the final configuration.

The existing fire alarm control panel is addressable.

2.1.7 Interface with Other Equipment

Interfacing components shall be furnished as required to connect to subsystems or devices which interact with the fire alarm system, such as supervisory or alarm contacts in suppression systems, operating interfaces for smoke control systems, door releases, etc.

2.2 STANDARD PRODUCTS

Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

2.3 NAMEPLATES

Major components of equipment shall have the manufacturer’s name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

2.4 CONTROL PANEL

Control Panel is an existing Siemens Emergency Voice/Alarm Communication Fire Alarm and Mass Notification Panel.

2.4.1 Remote System Audible/Visual Display

2.4.2 Circuit Connections

Connect circuit conductors entering or leaving the panel to screw-type terminals with each conductor and terminal marked for identification.

2.4.3 System Expansion and Modification Capabilities

Provide, as part of this contract, any equipment and software needed by qualified technicians to implement future changes to the fire alarm system.
2.4.4. Addressable Control Module

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems, and to control door holders or initiate elevator fire service. The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Class B notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled. Existing fire alarm system notification appliance circuits shall be connected to a single module to power and supervise the circuit.

2.4.5. Addressable Initiating Device Circuits Module

Configure the initiating device being monitored as a Class B initiating device circuits. The system shall be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling. The module shall be UL listed as compatible with the control panel. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled. Pull stations with a monitor module in a common backbox are not required to have an LED. Existing fire alarm system initiating device circuits shall be connected to a single module to power and supervise the circuit.

2.5. STORAGE BATTERIES

Furnish and install all new batteries for power supplies, including existing power supplies.

Submit substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Provide storage batteries which are 24 Vdc sealed, lead-calcium type requiring no additional water with ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 48 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Locate batteries at the bottom of the panel, or, in a separate battery cabinet. Provide batteries with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Paint the cabinets to match the fire alarm control panel.

2.6. BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. 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. Locate charger in control panel cabinet or in a separate battery cabinet.

2.7. ADDRESSABLE MANUAL FIRE ALARM STATIONS

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on flush mounted outlet boxes. Manual stations shall be mounted at 48 inches. Stations shall be [double 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 operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the mounting surface.

2.8. FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable, except where indicated.

2.8.1. Smoke Detectors

Design smoke detectors for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location.

2.8.1.1. Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

2.8.1.2. Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 6 feet and those mounted below 6 feet that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts to provide control, interlock, and shutdown functions. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

2.9. NOTIFICATION APPLIANCES
Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted red. Recessed audible appliances shall be installed with a grill that is painted red.

2.9.1. Alarm Horns

Not Used.

2.9.2. Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and the contract drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 15 candela. Strobe shall be semi-flush mounted.

2.9.3. Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

2.9.4. Voice Evacuation System

The voice evacuation system shall provide for one-way voice communications, routing and pre-amplification of digital alarm tones and voice (digital and analog) messages. The system shall be zoned for messages (Custom and prerecorded) and tones as indicated on the drawings. The following electronic tones shall be available from the amplifier: Slow Whoop, High/Low, Horn, Chime, Beep, Stutter, Wail and Bell. The system shall have a microphone and allow for general paging within the space. Operation shall be either manually from a control switch or automatically from the fire alarm control panel. Reset shall be accomplished by the fire alarm control panel during panel reset.

2.10. FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.10.1. Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.10.2. Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be fiber optic or copper cable in accordance with the manufacturers requirements. Wiring for fire alarm dc circuits shall be No. 16 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for style 5 addressable systems.

2.11. TRANSMITTERS – Existing to remain.

3. PART 3 EXECUTION
3.1. EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field and advise the Contracting Officer of any discrepancy before performing the work.

3.2. INSTALLATION

Install all work as shown, in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

3.2.1. Power Supply for the System

Provide a single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

3.2.2. Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. 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.

3.2.3. Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided. Detectors installed in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location.

3.2.4. Notification Appliances

Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

3.2.5. Addressable Initiating Device Circuits Module

The initiating device circuits module shall be used to connect supervised conventional initiating devices (water flow switches, water pressure switches, manual fire alarm stations, high/low air pressure switches, and tamper switches). The module shall mount in an electrical box adjacent to or connected to the device it is monitoring and shall be
capable of Style B supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on style B lines. Addressable initiating device circuits modules shall monitor only one initiating device each. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as specified in Section 21 13 13 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION, as indicated on the drawings and as specified herein.

3.2.6. Addressable Control Module

Addressable and control modules shall be installed in the outlet box or adjacent to the device they are controlling. If a supplementary suppression releasing panel is provided, then the monitor modules shall be mounted in a common enclosure adjacent to the suppression releasing panel and both this enclosure and the suppression releasing panel shall be in the same room as the releasing devices. All interconnecting wires shall be supervised unless an open circuit or short circuit abnormal condition does not affect the required operation of the fire alarm system. If control modules are used as interfaces to other systems, such as HVAC or elevator control, they shall be within the control panel or immediately adjacent to it. Control modules that control a group of notification appliances shall be adjacent to the first notification appliance in the notification appliance circuits. Control modules that connect to devices shall supervise the notification appliance circuits. Control modules that connect to auxiliary systems or interface with other systems (non-life safety systems) and where not required by NFPA 72, shall not require the secondary circuits to be supervised. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform required alarm functions as specified in Section 21 13 13 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION, as indicated on the drawings and as specified herein.

3.3. OVERVOLTAGE AND SURGE PROTECTION

3.3.1. Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges in accordance with IEEE C62.41.1/IEEE C62.41.2 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

3.3.2. Low Voltage DC Circuits Surge Protection

All IDC, NAC, and communication cables/conductors, except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges in accordance with IEEE C62.41.1/IEEE C62.41.2 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

3.3.3. Signal Line Circuit Surge Protection

All SLC cables/conductors, except fiber optics, shall have surge protection/isolation circuits installed at each point where it exits or enters a building. The circuit shall be protected from surges in accordance with IEEE C62.41.1/IEEE C62.41.2 B3 combination waveform and NFPA 70. The surge protector/isolator shall be rated to protect the equipment.

3.4. GROUNDING

Grounding shall be provided by connecting to building ground system.
3.5. SUPERVISING STATION PROVISIONS

The supervising equipment shall be existing to remain.

3.5.1. Revisions to Existing Facilities

Existing supervising components shall be modified as indicated on the drawings and programming shall be updated if required to accommodate the revised configuration. Acceptance testing shall include procedures that would demonstrate that operation of existing equipment has not been degraded and that the revised configuration plus interfacing components operates compatibly with the new fire alarm system at the protected premises. Work on existing equipment shall be performed in accordance with the manufacturer's instructions or under supervision of the manufacturer's representative.

3.5.2. Additions to Existing Facilities

Supplemental components shall be added to the existing supervising equipment [as required to accommodate the new fire alarm system to be installed at the protected premises] [as indicated on the drawings]. All present functions shall be extended, including recording and storage in memory, and programming shall be updated if required to accommodate the revised configuration. Acceptance testing shall include procedures that would demonstrate that operation of existing equipment has not been degraded and that the expanded configuration operates compatibly with the new fire alarm system.

3.6. TRAINING

Submit lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. Conduct the course in the building where the system is installed or as designated by the Contracting Officer.

a. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system. The training period for system expansions and modifications shall consist of at least 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

b. The maintenance training course shall provide the designated Government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system. Provide training course for the maintenance staff. The training period for systems maintenance shall consist of 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.

c. The training period for systems operation shall consist of 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features.

3.7. TESTING
Notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. Perform the tests in accordance with the approved test procedures in the presence of the Contracting Officer.

The control panel manufacturer’s representative shall be present to supervise tests. Furnish instruments and personnel required for the tests.

a. Submit detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

b. Submit test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. Include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

3.7.1. Preliminary Tests

Prior to the beginning of system installation, contractor shall test the existing system for faults and troubles. Provide testing certificate and report any existing issues of the system prior to starting work.

3.7.2. Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Conduct testing in accordance with NFPA 72. The recommended tests in NFPA 72 are considered mandatory and shall verify that previous deficiencies have been corrected. The Fire alarm Technician supervising the installation of the fire alarm system shall attend the testing of the system. The test shall include all requirements of NFPA 72 and the following:

a. Test of each function of the control panel.

b. Test of each circuit in both trouble and normal modes.

c. Tests of each alarm initiating devices in both normal and trouble conditions.

d. Tests of each control circuit and device.

e. Tests of each alarm notification appliance.

f. Tests of the battery charger and batteries.

g. Complete operational tests under emergency power supply.

h. Visual inspection of wiring connections.

i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.

j. Ground fault.

k. Short circuit faults.

l. Stray voltage.

m. Loop resistance.

--- END OF SECTION ---
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 within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 (2016) Standard for the Installation of Sprinkler Systems

UNIFIED FACILITIES CRITERIA (UFC)

UFC 3-600-01 (2016) Fire Protection Engineering for Facilities


UNDERWRITERS LABORATORIES (UL)

UL Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

Conduct a survey of the work area. Submit a record of existing conditions showing the results of the survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite.

Commencement of work constitutes acceptance of existing conditions.

Furnish piping offsets, fittings, and any other accessories as required to provide a complete installation and to eliminate interference with other construction. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

Provide working installation plans in accordance with UFC 3-600-01 and NFPA 13 for all areas of the system which are being modified as part of this scope of work.

Provide 4 modification to the existing wet pipe sprinkler system in areas indicated on the drawings. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13.

Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation. Design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.

1.2.1 Hydraulic Design

Provide hydraulic calculations for all new sprinkler and piping installations.

Hydraulically design the system to discharge a minimum density as indicated on the Fire Sprinkler Design Criteria on Sheet FP0.1. The minimum pipe size for branch lines in gridded systems shall be 1-1/4 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13.

1.2.1.1 Hose Demand
Add an allowance for exterior hose streams as indicated on the Fire Sprinkler Design Schedule on Sheet FP0.1.

1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply as indicated in the “Flow Test” schedule on Sheet FP0.1. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping.

1.2.1.3 Hydraulic Calculations

Submit hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments and as outlined in NFPA 13, except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable.

Calculations shall be based on the water supply data shown on the drawings to substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation.

Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe.

For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

1.2.2 Sprinkler Coverage

Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with NFPA 13, but shall not exceed the values indicated in the Fire Sprinkler Design Criteria Schedule on Sheet FP0.1.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00

SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Record of Existing Conditions G

SD-02 Shop Drawings

Supporting Elements G

Fire Alarm System G

Sprinkler System G
1.4 QUALITY ASSURANCE

Compliance with referenced NFPA standards is mandatory. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification governs. Interpret reference to "authority having jurisdiction" to mean the Contracting Officer.

1.4.1 Plans and Calculations

Perform work specified in this section under the supervision of and certified by the Fire Protection Specialist who is an individual registered professional engineer who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES) in a related engineering discipline with a minimum of 5 years' experience. Submit the name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

The Fire Protection Specialist shall prepare and submit a list of the fire protection related submittals, no later than 7 days after the approval of the Fire Protection Specialist, from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.2 Sprinkler System Installer

Work specified in this section shall be performed by the Sprinkler System Installer who is regularly engaged in the installation of the type and complexity of system specified in the contract documents, and who has served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months. Submit the name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

1.4.3 Shop Drawings

Shop Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13 and UFC 3-600-01. Submit 3 hard copies or 1 digital (PDF) copy of the Sprinkler System shop drawings, no later than 21 days prior to the start of sprinkler system installation. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:
a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1/8" = 1'-0" which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector’s test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. 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; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring. Submit load calculations for sizing of sway bracing, for systems that are required to be protected against damage from earthquakes.

1.5 DELIVERY, STORAGE, AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.6 EXTRA MATERIALS

Submit spare parts data 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. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of such products and that 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

Provide Materials and Equipment that have been tested by Underwriters Laboratories, Inc. and are listed in UL Fire Protection Directory or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in THE UL Fire Protection Directory or FM APP GUIDE.

Submit manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, provide a complete equipment list that includes equipment description, model number and quantity.

2.3 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel.

WET PIPE SPRINKLER SYSTEMS 13915-4
2.3.1 Steel Piping Components

2.3.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A795/A795M, ASTM A53/A53M, or ASTM A135/A135M. Pipe in which threads or grooves are cut or rolled formed shall be Schedule 40 or shall be listed by Underwriters Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut or rolled formed. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.3.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.3.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A47/A47M, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.

2.3.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16-inch-thick, and full face or self-centering flat ring type.

2.3.1.5 Bolts, Nut, and Washers

Bolts shall be conform to ASTM A449, Type 1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque. Nuts shall be hexagon type conforming to ASME B18.2.2, ASTM A193/A193M, Grade 5, or ASTM A563M ASTM A563, Grade C3 or DH3. Washers shall meet the requirements of ASTM F436M ASTM F436. Flat circular washers shall be provided under all bolt heads and nuts.

2.4 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Temperature classification shall be ordinary unless required otherwise by a nearby heat source or where required by NFPA 13.

Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used.

Sprinkler types shall be as indicated on Fire Sprinkler Schedule, Sheet FP0.1.

2.4.1 Recessed Sprinkler

Recessed sprinkler shall be white polyester and shall have a nominal 1/2 inch or 17/32-inch orifice.

2.4.2 Upright Sprinkler

Upright sprinkler shall be brass and shall have a nominal 1/2 inch or 17/32-inch orifice.
2.5  ACCESSORIES

2.5.1  Sprinkler Cabinet

At least two sprinklers of each type on this project shall be added to the existing spare sprinkler cabinet.

2.5.2  Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.5.3  Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

2.5.4  Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located as indicated on the drawings.

2.6  EQUIPMENT

2.6.1  Aboveground Piping Materials

2.6.1.1  Type BCS - Black Carbon Steel

Pipe 1 through 2 inches: Schedule 40 furnace butt weld black-carbon steel conforming to ASTM A53/A53M, or ASTM A135/A135M, Type F furnace butt welded.

Pipe 2-1/2 through 8 inches, where indicated: Schedule 40 black carbon steel, conforming to ASTM A135/A135M, Grade B or Schedule 10 where not threaded.

Unions 2 inches and under: 300-pound per square inch gage (psig) working steam pressure (wsp) female, screwed, black malleable iron, with ground joint and brass-to-iron seat conforming to ASME B16.39.

Standard pipe couplings: Extra-heavy screwed black steel.

Grooved pipe couplings (all sizes): 175-psig minimum working pressure with a housing fabricated in two or more parts of black malleable-iron castings. Provide coupling gasket molded of synthetic rubber, conforming to requirements of ASTM D2000. Provide coupling bolts that are oval-neck, track-head type with heavy hexagonal nuts, conforming to ASTM A183.

Fittings 4 inches and under: 175-psig working pressure, cast iron, screwed, conforming to ASTM A126, Class A, and ASME B16.4.

Fittings 6 inches and larger: 175-psig working pressure, cast iron, conforming to ASTM A126, Class A, screwed, conforming to ASME B16.4, or flanged, conforming to ASME B16.1.

Grooved fittings (all sizes): ensure 175-psig working pressure fittings used with grooved couplings are fabricated of black malleable-iron castings. If a manufacturer’s standard-size malleable-iron fitting pattern is not available, use fabricated fittings. Fabricate fittings from Grade B seamless-steel pipe and long-radius seamless welding fittings, with wall thickness to match pipe, conforming to ASTM A234/A234M and ASME B16.9.

2.6.1.2  Pipe Labeling
Pipe shall be labeled by painting enable bands or providing pre-printed labels every 20 feet and on both sides of wall, ceiling, or floor penetration, in accordance with UFC 3-600-01.

2.6.2 Supporting Elements

Provide piping system components and miscellaneous supporting elements, including, but not limited to, building-structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical-pipe attachments; horizontal-pipe attachments; restraining anchors; and guides. Ensure supporting elements are suitable for stresses imposed by systems pressures and temperatures, natural, and other external forces.

Provide FM approved or UL listed supporting elements conforming to ASME B31.1, MSS SP-58, and ASME B16.34.

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 13.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST/FIRE PROTECTION ENGINEER

Fire Protection Specialist shall be a registered Fire Protection Engineer who shall comply with the following:

Prior to ceiling installation and concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist/Fire Protection Engineer that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

The Fire Protection Specialist shall: 1) inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements, 2) witness the preliminary and final tests, and sign the test results, 3) after completion of the system inspections and a successful final test, certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 ABOVEGROUND PIPING INSTALLATION

3.4.1 Piping in Exposed Areas

Install exposed piping without diminishing exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.4.2 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.4.3 Pendent Sprinklers
Drop nipples to pendant sprinklers shall consist of minimum 1-inch pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendant sprinklers when the arm-over exceeds 12 inches for steel pipe.

Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1-inch below the underside of the ceiling. On pendant sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 4 inches.

Recessed pendant sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid.

3.4.4 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

3.4.5 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up.

Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site.

Flanged joints 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 specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools shall be products of the same manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application.

Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.4.6 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.

3.4.7 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast-iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07 84 00 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.
3.4.8 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.4.9 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.5 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. Submit proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests and proposed date and time to begin the preliminary tests. The aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13. Upon completion of specified tests, submit 3 copies of the completed Preliminary Test Report, no later than 7 days after the completion of the Tests. The Report shall include both the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

3.5.1 Aboveground Piping

3.5.1.1 Hydrostatic Testing

Aboveground piping 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 and shall maintain that pressure without loss for 2 hours. There shall be no drop-in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.5.1.2 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

3.5.1.3 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

3.6 FINAL ACCEPTANCE TEST

Begin the Final Acceptance Test only when the Preliminary Test Report has been approved. Submit proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests, and proposed date and time to begin the Test, submitted with the procedures. Notification shall be provided at least 14 days prior to the proposed start of the test.

Notification shall include a copy of the Contractor's Material & Test Certificates. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches.

After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. Submit as-built shop drawings, at least 14 days after completion of the Final Tests, updated to reflect as-built conditions after all related work is completed. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until
identified discrepancies have been corrected and test documentation is properly completed and received.

Submit 3 copies of the completed Final Acceptance Test Report no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist as specified.

3.7 ONSITE TRAINING

The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit proposed schedule, at least 14 days prior to the start of related training. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. Submit 6 Operating and Maintenance Manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4-hour on-site response to a service call on an emergency basis. The Onsite Training shall cover all of the items contained in the approved manuals.

-- End of Section --
PART 1 - GENERAL

1.1 WORK INCLUDES

A. General Provisions of the contract, including the following, shall apply to Division 15 Specification Sections: Solicitation Documents and Division 1.

B. The Work to be performed under this Division shall include all labor, materials, equipment, transportation, construction plant, and facilities necessary to provide a complete and satisfactory system ready to use. Wherever the words “the Contractor” or “this Contractor” appears in this Division, they refer to the Contractor for the work specified in that Section. This Contractor shall examine all Drawings and all Sections of the Specifications and shall be responsible for ascertaining to what extent other Drawings and Sections affect the Work herein specified.

1.2 CODES, REGULATIONS, AND STANDARDS

A. All work must be performed in accordance with the requirements of local, county, state and national codes and regulations including the requirements of the following:

4. 2015 International Mechanical Code.
5. Occupational Safety and Health Act. of 1970
7. For work not specifically listed above, use standards and codes of the National Fire Protection Association.

B. All equipment, apparatus and systems shall be rated, tested, fabricated and/or installed in accordance with the applicable industry standard mentioned. The following list will serve to clarify abbreviations that appear in other sections of this specification:

1. AABC Associated Air Balance Council
2. ADC Air Diffusion Council
3. AGA American Gas Association.
4. AMCA Air Moving and Conditioning Association
5. ARI Air Conditioning and Refrigeration Institute
6. ANSI American National Standards Institute
7. ASE Association of Safety Engineers
8. ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineer
9. ASME American Society of Mechanical Engineers
10. AWWA American Water Works Association
11. EPA Environmental Protection Agency
12. FS Federal Specifications
13. IBR Institute of Boiler and Radiator Manufacturers
14. IEEE Institute of Electrical and Electronics Engineers
15. MCAA Mechanical Contractors' Association of American
16. NEMA National Electrical Manufacturers Association
17. NSC National Safety Council
18. NSF National Sanitation Foundation
19. SBI Steel Boiler Institute Industry
20. SMACNA Sheet Metal and Air Conditioning Contractors National Association
21. UL Underwriters Laboratories
GENERAL PROVISIONS

1.3 DEFINITIONS

A. FURNISH: The term furnish means supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation and similar operations.

B. INSTALL: The term install describes operations at the Project Site including the actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.

C. PROVIDE: The term provides means to furnish and install, complete and ready for intended use.

1.4 SHOP DRAWINGS AND SUBMITTALS

A. See Section 01340 for requirements for shop drawings and product data.

B. Asbestos-Free Material/Product: Prior to approval of the material/product to be used, the manufacturer/supplier shall furnish the Contracting Officer with written certification that the material/product contains no asbestos. This certificate is mandatory before approval will be issued. Submittals furnished without the asbestos-free certification will be returned to the Contractor with no action taken until such certification is provided.

C. See applicable sections to this Division for items requiring shop drawings.

1.5 MATERIALS AND WORKMANSHIP

A. Materials, the style, make or quality of which is specifically designated, shall be as specified.

B. Contractor shall furnish necessary materials in ample quantities and as frequently as required to avoid delay in the progress of the Work, and shall so store them as to prevent interference with other work.

1.6 DEFECTIVE WORK AND MATERIAL

A. All materials or work found to be defective or not in strict conformity with the drawings or different from requirements of the drawings and specifications or defaced or injured through negligence of Contractor or his employees, or through action of fire or weather will be rejected and shall be immediately removed from premises by Contractor and satisfactory materials and work substituted without delay.

B. All defective work or imperfect work shall be corrected immediately on notice from Contracting Officer. No previous inspection or certificate on account shall be held to relieve Contractor from his obligation to furnish sound materials and to perform good and satisfactory work.

1.7 COOPERATION AND COORDINATION

A. Contractor shall confer with other contractors at the site before installing his work to avoid interferences so that maximum head room and clearances may be maintained. In event that interferences develop between work of various contractors, Contracting Officer’s
decision will be final and no additional compensation will be allowed for changes required.

B. Particular attention shall be paid to situations where recessed equipment, pipes and lights occur, or where the work of several trades occurs together above suspended ceilings, in pipe shafts or in areas where space is limited.

C. All fixtures, equipment, devices, switches, outlets, pumps, etc., shall be positioned to avoid all interferences with and to assure proper coordination with work of all other trades, cases, partitions, wall, floor and ceiling patterns, architectural features, etc. All recessed devices, fixtures, etc., shall be coordinated with all wall, floor and ceiling patterns. Contracting Officer will reconcile conflicts and adjustments where such adjustments are warranted.

1.8 PROTECTION OF EQUIPMENT AND SYSTEMS

A. Contractor shall keep all his respective pipe openings closed by means of plugs or caps to prevent entrance of foreign matter during construction and cover all fixtures, equipment, and apparatus as required to protect them against dirt, water, chemical or mechanical damage both before and after installation. Any such fixtures, equipment or apparatus damaged prior to final acceptance of the Work shall be restored to its original condition or replaced by Contractor at no cost to Owner.

1.9 CONTRACT DRAWINGS

A. The layout shown on the Contract Drawings is diagrammatic but shall be followed as closely as actual construction and as other work will allow. The dimensions of work as shown on the Contract Drawings are not as-built dimensions. No measurements shall be scaled from the drawings and used as definite dimensions for laying out or fitting work in place.

B. The layout of manufactured equipment as shown on the drawings shall be checked and the exact location shall be determined from the dimensions of equipment shop drawings approved by the Contracting Officer.

1.10 MAINTENANCE MANUAL AND OPERATING INSTRUCTIONS

A. Upon completion of the Work, Contractors shall provide the Contracting Officer with three copies of maintenance manual for all equipment furnished and installed under his Work. Manuals shall be in substantial 3-ring binders with project name and number inscribed on face and hinged back. Manual shall include roster of all AAFES and Installation training session attendees. The manual shall, however, first be approved by the Contracting Officer.

B. The manual shall include manufacturer's lubricating and operating instructions and parts list and serial numbers for all operating machinery, including drive information, and motor horsepower, amperage, and voltage readings on all phases, valve chart, sequence of operation, index following the order listed in the specifications, warranties in the name of the Installation, and a list of manufacturers, service firms and subcontractors names and telephone numbers.

C. Training attendance rosters for each training session shall be included in manuals. Roster will identify training subject, date, attendees name, job title, office symbol, grade/rank, and telephone number.

D. All switches, controls, and safety devices shall be clearly and permanently marked with
embossed or printed plates as to purpose and as to operation and shall be tested in the presence of the Owner designated representative to ensure that he understands their function and purpose.

E. Upon completion of the Work, Contractors shall put the systems into service. Contractors shall be entirely responsible for the equipment during all testing operations including the lubricating and turning on and off of such apparatus.

1.11 SUBSTITUTION OF EQUIPMENT

A. The contractor may offer to substitute equipment other than those specified for approval of the Contracting Officer. The request for substitution of equipment shall be submitted by the Contractor to the Contracting Officer within fifteen (15) calendar days after award of the contract. It is incumbent on the Contractor to submit technical data that will fully establish the equality of the proposed substitute equipment with that specified and evidence to substantiate the availability of the required repair and maintenance service. Each request for substitution shall be accompanied by the following information for each piece of equipment:

1. Statement indicating that this substituted equipment will not increase the contract cost nor extend the completion date.
2. Manufacturer's name and model number.
3. Catalog cuts, diagrams and other data published by the manufacturer with the particular model identified and the pertinent design data for that model highlighted or underlined for easy reference.
4. Parts lists and recommended spare parts required for preventive maintenance and minor field repairs.
5. Each request for substitution shall also include the following information relating to service maintenance and repair:
   a. Name, address and telephone number of nearest factory authorized technical representative.
   b. Name, address and telephone number of firm(s) qualified to perform preventive maintenance, minor or major repairs in the locale of the project.
   c. Name, address and telephone number of firm(s) from whom spare parts and major components are available.
   d. Building name and address, and the name, address and telephone number of its owner's representative where equipment of the same manufacturer as that requested for substitution has been installed and in operation for two or more years. Two or more such installations shall be listed and the location should be in the vicinity of the proposed project.

B. In the event of Contracting Officer's approval of a substitution of equipment, the Contractor will be notified by telephonic message by the Contracting Officer (or authorized representative), followed by the issuance of an amendment to the contract incorporating the equipment by name and model number.

1.12 PROJECT RECORD AND CLOSEOUT DOCUMENTS

A. See Section 01720 for red lining of all documents during construction to reflect "as-built" conditions.

1.13 APPROVED MECHANICAL EQUIPMENT

A. Contractor's proposal shall be based on furnishing and installing any of the mechanical
equipment listed in the individual specification sections. This listing of mechanical equipment has been determined by the Contracting Officer as meeting the requirements of the construction documents, and competent maintenance and repair service has been determined to be available in the locale of the project. The determination of availability of this equipment within the time required for contract performance is the responsibility of the Contractor.
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section of the specifications includes the cleaning and the testing and the adjusting of all various plumbing systems and equipment for mechanical strength, leakage and performance.

B. Upon completion of the work, the Contractor shall make such tests as are hereinafter specified or as may be required by the Contracting Officer.

C. All tests shall be conducted in the presence of the Contracting Officer or his authorized representative.

D. The entire cost of all tests, inspections, permits, etc., shall be borne by the Contractor at no additional cost to the Government, unless otherwise directed in writing.

E. Certificates, where such are required, shall be executed and turned over to the Contracting Officer.

1.2 GENERAL REQUIREMENTS

A. The Contractor shall provide all apparatus, temporary piping, connections or any other requirements necessary and shall take all due precautions to prevent damage to the building and its contents as may be incurred during tests. The Contractor shall repair or make good at his own expense any damage to the building and/or its contents resulting from tests.

B. Elements of the various systems, equipment, etc., which might be damaged during testing shall be removed (or otherwise protected) for the period of the test and replaced thereafter.

C. Any leaks, defects, or deficiencies discovered as a result of the tests shall be immediately repaired or made good, and tests shall be repeated until test requirements are fully complied with. Defective materials shall be replaced. Caulking, puttying, painting or rusting to correct leaks in pipe or pipe joints will not be permitted.

1.3 PERFORMANCE TESTS

A. Operating tests to determine performance shall be conducted of each completed system and its associated equipment.

B. Where major items of Government-furnished equipment are included in a system, it is the Contracting Officer's responsibility to have a factory representative available when required.

C. The Contractor shall be responsible for notifying the Contracting Officer in writing of the test data sufficiently in advance to allow the timely request for the representative. In the event that testing cannot proceed immediately upon the arrival of the factory representative, and if the delay incurred is due to incomplete work or improper preparation of the work by the Contractor, the Contractor shall bear all costs of the factory representative for the period of the delay.

D. Performance tests shall be conducted in a manner that will demonstrate satisfactorily the ability of the systems and equipment to perform as specified under design conditions.

1.4 MECHANICAL STRENGTH AND LEAKAGE TESTS

A. All tests hereinafter specified shall be conducted before backfilling, insulating, or other form of concealment is completed.
B. It is desirable that each system be tested in its entirety but the various systems may be tested in sections as may be required to expedite the work of other trades.

1.5 CLEANING EQUIPMENT AND SYSTEM

A. All equipment, piping systems and duct systems shall be thoroughly cleaned internally and externally before being placed in service.

B. The Contractor is charged with the responsibility for maintaining all systems and equipment clean and free of foreign matter during the processes of assembly and erection.

C. Pipe strainers and air filters shall be cleaned and serviced immediately prior to final inspection.

D. When flushing systems, all control, thermal and other elements subject to blocking by foreign matter shall be removed.

E. When piping systems are flushed with fluids other than that normally contained, the Contractor shall take adequate precautions to ensure that the normal contents of the piping will not be contaminated when placed in service.
PART 1 - GENERAL

1.1 WORK INCLUDES

A. Provide all material as specified in this Section.

1.2 SUBMITTALS

A. Submit shop drawings in accordance with Section 15010 for the following devices:

1. Pipe and fittings.
2. Pipe hangers and supports.
3. Valves.
4. Access panels and doors.

B. Submit certificates of compliance for pipe, fittings and valves specified under this section. All material shall be manufactured in the United States.

1.3 QUALITY ASSURANCE

A. Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place.

B. Code ratings, labels or other data which are die-stamped or otherwise affixed to the surface of the equipment shall be in easily visible location.

1.4 PRODUCT DELIVERY STORAGE AND HANDLING

A. Follow manufacturer's directions in delivery, storage, protection and handling of all equipment and materials.

B. Deliver and store equipment and materials to the site in original containers, suitably sheltered from the elements and mechanical injury, but readily accessible for inspection until installed.

C. Items subject to moisture damage shall be stored in dry, heated spaces.

D. Ascertain, from examination of architectural drawings, whether any special temporary access openings in the building(s) will be required for admission of apparatus furnished under this Division and notify General Contractor accordingly.

E. In event of failure to give sufficient notice in time to arrange for access openings during construction, contractor assume all costs of providing such openings thereafter.

F. Heavy machinery, equipment and heavy parts thereof shall be brought into building or onto premise by a machinery moving concern acceptable to Contracting Officer.

G. Machinery movers shall not rig, tie to, or rest weight upon any building member of any part of building premises or make use of any stairway until specific permission is obtained from Contracting Officer.

H. Permission to rig to or in any way make use of any part of building premises shall not relieve Installer of responsibility for any damage resulting from, or because of said rigging or use.
I. No holes shall be cut in any wall, roof or floor for introduction of machinery except when absolutely necessary and approved by Contracting Officer.

J. Approved holes will be cut and repaired by the proper trades at the expense of the trade requesting them.

1.5 PROTECTION

A. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter, and cover all fixtures, equipment and apparatus as required to protect them against dirt, water, chemical or mechanical damage both before and after installation.

B. Fixtures, equipment or apparatus damaged prior to final acceptance of work shall be restored to original condition or replaced by Installer.

C. Equipment shall be inherently safe and moving parts shall be covered with guards which meet OSHA requirements.

D. Provide protective guards for devices such as or similar to thermostats, valves, and switches which are so located as to be readily subject to tampering, accidental damage, or vandalism.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. All piping and fittings shall be manufactured in the United States. Each length of pipe and each fitting shall be marked with the manufacturer's name or trademark and the specification code to which it conforms.

B. Underground and above ground sanitary soil, waste and vent, and storm water piping systems: Contractor provide one or a combination of the following:

1. Service weight cast iron hub and spigot pipe with drainage pattern cast iron fittings conforming to ASTM A74. Joints shall be push on type utilizing neoprene molded rubber tight sealing gasket conforming to ASTM C564.

2. Hubless cast iron pipe with drainage pattern cast iron fittings conforming to Cast Iron Soil Pipe Institute Standards 301-67T. Joints shall be made with neoprene sealing steel and stainless steel clamp and shield assembly.


C. Above ground domestic cold and hot water piping systems:

1. Type L or K hard drawn copper tubing conforming to ASTM B88 with wrought copper or cast brass solder fittings conforming to ANSI B16.22. All joints shall be made with lead free solder and water soluble binder flux or pressure joining system similar to Viega "Pro Press."

D. Above ground gas piping: schedule 40 black steel pipe with welded steel fittings 2-1/2” and over and threaded malleable iron fittings 2” and under. All new piping, fittings and valves on roof shall be painted with two coats of yellow corrosion resistant paint.

E. Grease reclaim piping shall be schedule 40 black steel piping with threaded cast iron fittings.

2.2 PIPE SPECIALTIES
A. Unions in copper pipe 2 in. and smaller shall be Mueller, Anaconda or Chase Brass, brass solder joint unions constructed for 150 psi working pressure.

B. Dielectric unions or brass adapters suitable for dielectric service shall be provided at pipe connections between steel or cast iron piping, and at gas meter.

2.3 HANGERS, SUPPORTS AND INSERTS

A. Hangers and supports shall conform to the recommendations of Standard Practice SP.58 of the Manufacturers' Standardization Society of the Valve and Fitting Industry.

B. Hangers shall be as follows:

<table>
<thead>
<tr>
<th>Manufacturers</th>
<th>Grinnell</th>
<th>Elcen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulated piping:</td>
<td>300</td>
<td>12X</td>
</tr>
<tr>
<td>Non-insulated piping:</td>
<td>260</td>
<td>12</td>
</tr>
<tr>
<td>Copper tubing: Non-insulated</td>
<td>CT-65</td>
<td>312</td>
</tr>
</tbody>
</table>

C. Riser clamps shall be as follows:

<table>
<thead>
<tr>
<th>Manufacturers</th>
<th>Grinnell</th>
<th>Crawford</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piping all sizes:</td>
<td>261</td>
<td>36</td>
</tr>
<tr>
<td>Copper tubing riser clamps shall be copper plated.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D. Where several pipes occur at the same elevation, trapeze type hangers may be used. Trapeze hangers shall be made of 2 inch x 2 inch structural steel channels with legs down and steel blocking of varying thickness welded to channel under each pipe to obtain proper pitch. All copper tubing supports shall be copper plated or insulated from dissimilar materials.

E. Hanger rods shall conform to the following:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Rod Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2&quot;</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; to 3&quot;</td>
<td>5/8&quot;</td>
</tr>
<tr>
<td>4&quot; to 8&quot;</td>
<td>3/4&quot;</td>
</tr>
</tbody>
</table>

Trapeze hanger rods shall be of sufficient size to carry weight of Trapeze channel, piping and contents, insulation supports and an additional 200 lb. load.

F. Wire or perforated strap iron hangers, expansion anchors, and power actuated fasteners will not be permitted.

G. Hangers for PVC piping shall comply with manufacturer's recommendations.

2.4 SLEEVES

A. Provide pipe sleeves for all penetrations of piping through floors and walls.

B. Floor sleeves shall be standard weight galvanized steel pipe with bottom set flush with surface below and top extending 1" above finished floor (3" in mechanical equipment rooms). Seal around pipe and pipe sleeve with fire resistant waterproofing caulking materials.

C. Wall sleeves for interior partitions and ceilings shall be 20 gauge galvanized steel with lock joints.
D. Sleeves for piping that is to be insulated shall be large enough to allow insulation to pass through the sleeve. Refer to Section 15250 "Insulation" for specific thicknesses of insulation.

E. Pack the space between the interior surface of all sleeves and pipes or pipe insulation with fire resistant, sound and waterproofing caulking materials.

2.5 ESCUTCHEONS

A. Provide set-screw chrome plated escutcheons (not friction-dependant) on all exposed pipe or pipe insulation passing through or into finished walls, partitions, ceiling and floors. Escutcheons at insulated pipes shall be large enough to encircle insulation without penetrating vapor barrier or jacket.

2.6 VALVES

A. Other sections having specific valve requirements take precedence over this Section. In general, gate valves shall be provided at each of the locations listed below, whether indicated on the drawings or not:

1. At each branch take-off from a main to equipment.
2. At each take-off from each riser.

B. A "run-out" shall be defined as a line feeding one single piece of equipment and a branch shall be defined as a line feeding more than one piece of equipment.

C. All valves shall have the name, trademark or initials of the manufacturer cast thereon and shall be identified by catalog number. All screwed ends of valves shall have threads conforming to the American Standard for Pipe Threads. Unless otherwise specified, valves 2" and smaller shall be all brass or bronze construction with screwed ends and valves 2-1/2" and larger shall be iron bodied with brass or bronze trim.

D. Pipe size reductions, where necessary because of equipment connection sizes or automatic valve sizes, shall be made with the proper eccentric reducing fittings immediately adjacent to the inlet and outlet of the equipment or automatic valve. Provide concentric increasers on pump discharge piping.

E. Ball, Gate, Globe, and Check Valves:

1. For domestic cold and hot water copper piping (100 psig or less):

<table>
<thead>
<tr>
<th>Ball Valves:</th>
<th>NIBCO-SCOTT</th>
<th>ITT GRINNEL</th>
<th>CRANE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and smaller</td>
<td>70-200</td>
<td>2182</td>
<td>T-580</td>
</tr>
</tbody>
</table>

2. For valves in copper piping, equivalent solder end or press fit valves shall be used.

2.7 ACCESS PANELS

A. Contractor shall so arrange piping that all concealed valves and/or concealed equipment can be operated and/or properly maintained through access panels. Contractor shall be responsible for so informing and cooperating with Contracting Officer in locating panels so that they will be the least obtrusive and will work best in the architectural treatment of respective rooms.

B. Contractor shall furnish proper number of access panels required for his Work and give them to Contractor designated to install same. Access panels shall be of sufficient size to
adequately maintain valves and equipment. Panels shall be of type listed as follows:

1. Style K - plastered surfaces. Frame will be clearly visible.
2. Style M - masonry and tile.

C. Provide "B" label panels where located in fire walls.

D. Manufacturers for access panels:
   2. Bilco Company.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILLING

A. This Contractor shall do all excavation and backfilling and rock excavation required for installation of all of the work requiring excavation, and shall provide all necessary sheeting and bracing required to properly protect his workmen and facilitate the work.

B. Pipe trenches shall be excavated to lines and grades as shown on drawings or as approved by the Contracting Officer. Bell holes shall be excavated to insure firm support for the pipe on undisturbed earth for the full length of the pipe except the necessary clearance at joints for construction and inspection. Over excavated or unfirm ground shall be brought up to the proper level with sand, or with pit run gravel, thoroughly compacted in place. Width of trench shall be such as to readily permit making of joints.

C. As piping is laid in the trench, sand shall be backfilled along each side of the pipe and carefully compacted so as to securely hold the pipe in place, leaving the top half of the pipe exposed for its entire length, and the joints all around completely exposed for inspection by the Contracting Officer. No additional backfilling shall be placed until the inspection has been completed and tests herein specified have been made and approved. This contractor shall backfill all trenches as rapidly as testing and acceptance will permit.

D. Backfill for a depth of 1 ft. above the top of the pipe shall be sand, free from rocks or other foreign materials, and shall be placed and hand tamped uniformly so as to avoid damaging or disturbing the alignment of the pipe. Completely backfill top of trench with compacted sand or pit run gravel.

E. All excess excavated material resulting from this Work shall be deposited by the Contractor in location directed by the Contracting Officer.

F. This Contractor shall establish and maintain all elevations and lines required for the installation of sewers and water lines.

G. All elevations, grades and lines shall be set with the aid of transit and level by this Contractor, and he shall be responsible for their protection while being used.

H. Sheet and brace trenches and remove water as necessary to fully protect workmen and permit proper installation of the work. Comply with local regulations or, in the absence thereof, with the provisions of the "Manual of Accident Prevention on Construction," of the Associated General Contractors of America, Inc. Under no circumstances lay pipe or install appurtenances in water; keep the trench free from water until pipe joints have been
completed. The presence of ground water in the soil or the necessity of sheeting or bracing trenches shall not constitute a condition for which an increase may be made in the Contract Price; except that when sheeting is left in place, on the written order of the Contracting Officer, the Contract Price shall be adjusted. Sheetin left in place shall be cut off not less than 2 ft. below finished grade. Sheetin shall not be removed until the trench is substantially backfilled.

3.2 JOINTING OF PIPING

A. Threads shall be full and clean cut, and ends of pipe shall be reamed. When screwed joints are assembled, the male thread shall be thoroughly coated with Teflon paste or an aerobic curing thread sealant to serve as a joint sealer. Paint all the exposed threads. (Teflon tape may be used at contractor's option.) Care shall be taken to keep the paint and all other foreign matter from entering the interior of the piping. Each section of pipe and all fittings shall be carefully inspected for dirt, grease, or other foreign matter on the inside and where necessary they shall be properly cleaned before assembly. It shall be the Contractor's responsibility to thoroughly clean the piping systems after completion to the satisfaction of the Contracting Officer in cases where proper cleaning was not done at time of installation.

B. Soldered or brazed joints made with fittings having pre-inserted rings of solder or brazing alloy shall have the tube and fittings cleaned bright and fluxed. The joint shall be heated sufficiently to make a tight connection. Tubes and fittings without such rings, shall be cleaned bright, fluxed and heated until the solder is drawn into the joint by capillarity and the connection is tight. Flux shall be water soluble binder flux. All solder and flux shall be lead free.

C. Solvent cement joints shall use cement that complies with 40 CFR 59, subpart D and manufacturer's recommendations.

3.3 EXPANSION AND CONTRACTION

A. Provisions shall be made for expansion and contraction in all piping. Piping shall be installed in a manner such that joints will not develop leaks. All expansion shall be taken up by swing-connections, and this Contractor shall be responsible for the installation of these connections whether or not they are shown on the Drawings with specific means for relieving expansion and contraction. Slip-type expansion joints shall not be used. Particular care must be exercised at branches on underground piping to allow free movement at branch connection to main.

3.4 INSTALLATION OF PIPING

A. Piping shall be installed on long continuous lengths, with a minimum number of joints. Joints, where necessary shall be carefully made to insure against leakage.

B. All piping shall be installed using hangers, brackets and braces to prevent sagging and/or lateral movement. All hangers, brackets, and other supports shall be securely fastened to the construction as may be required and in a manner acceptable to the Contracting Officer. All piping shall be installed to maintain maximum head room. Nothing shall be suspended from the roof deck.

C. Arrangement of all piping shall be as shown on plans. It is especially necessary that all mains be installed with view to accessibility in case of repair and location of pipe lines and spacing between same shall be so made that there will be no conflict between pipe lines by the several trades.
D. Contractor shall give careful consideration to clearances and locations of lines and type of fittings used to obtain these clearances. Provide maximum headroom in all cases. Piping shall be installed parallel to building walls and at a height so as not to obstruct any portion of a window, light fixture, doorway, pipe tunnel or passageway. Ascertain from the drawings heights of all suspended ceilings, size of all pipe shafts in which piping is to be concealed, and location and size of structural members in and adjacent to all pipe shafts.

E. Where interferences develop in the field, Contractor shall offset or reroute piping as required to clear such interferences. In all cases consult architectural drawings for exact location of pipe spaces, ceiling heights, or other architectural details before installing piping.

F. At the low point in piping, and elsewhere as shown on the drawings, install a dirt pocket at least 6 in. deep with a cap at bottom constructed of pipe fittings not less than 3 in. for connections 3 in. and larger and of the full diameter of the connection served where smaller than 3 in.

G. Under no circumstances shall the size of piping shown on the drawings be changed without written approval of the Contracting Officer.

H. Provide eccentric reducers where required for proper drainage or venting of horizontal pipe lines. Reducing fittings shall be used for all changes of pipe size and bushings shall not, under any circumstances, be used.

I. Unions or flanges are to be installed on the equipment side of all valves in pipe connections from mains to equipment, to enable equipment to be drained and disconnected without necessitating the draining of mains.

J. Valves must be arranged for easy access and be within easy reach and the piping shall be arranged to accomplish this.

K. Natural gas piping installation shall comply with NFPA-54.

3.5 PIPE SLEEVES

A. Pipe sleeves shall be securely bedded in the building construction. Sleeves shall finish flush with finished wall and ceiling lines. Note that where covering is provided, it shall extend continuously through sleeves.

B. Sleeves installed in vertical positions shall be perfectly plumb and sleeves in horizontal positions shall be level. They shall be located, set, and maintained in position by this Contractor while surrounding construction work is being installed so that the center of each pipe shall be accurately installed in the center of its sleeve. The space between the pipe or the insulation and the sleeve shall be caulked to prevent light or air transfer. Where vertical sleeves occur, such as in floors or ceilings, special collars secured to the pipes or to the ceiling construction shall be provided to prevent the packing from falling out. The standard floor and ceiling plates herein specified for finished areas may be used for this purpose provided they are firmly secured to the pipes.

3.6 HANGERS, SUPPORTS AND INSERTS

A. Provide all hangers, supports, bracing, inserts, beams, anchors, guides, sleeves and miscellaneous steel for the proper support, alignment, expansion and contraction of piping and equipment.
B. Hanger supports shall be securely fastened to structural members by approved beam clamps and clips, concrete inserts, anchors, or other appropriate methods agreed upon with the Contracting Officer.

C. Maximum spacing of hangers and supports for steel piping shall be as follows:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot; and 3/4&quot;</td>
<td>Not over 6'-0&quot;</td>
</tr>
<tr>
<td>1&quot; and 1-1/4&quot;</td>
<td>Not over 8'-0&quot;</td>
</tr>
<tr>
<td>1-1/2&quot; thru 3&quot;</td>
<td>Not over 10'-0&quot;</td>
</tr>
<tr>
<td>4&quot; and 6&quot;</td>
<td>Not over 12'-0&quot;</td>
</tr>
</tbody>
</table>

D. Hanger and support spacing for copper piping shall not exceed 8 ft. on centers.

E. Cast iron or bell and spigot piping shall be supported at every joint.

F. Additional hangers and supports shall be provided to minimize undesirable stress on valve bodies, other fittings and equipment.

G. Provide all supplemental angles, channels and plates of adequate sizes where bracing or supports are required for piping between structural members.

3.7 OPENINGS IN CONSTRUCTION

A. Openings required in new construction will be provided by the Contractor at the request of, and in accordance with, information furnished by this Contractor. If this Contractor fails to request or furnish information to the Contractor for the placement of holes in new construction or fails to furnish sleeves at the time the General Contractor is ready to place such construction, such holes shall be cut after the construction is in place by this Contractor in accordance with the paragraph below.

B. All cutting required that may be necessary for the installation of this Work shall be done by this Contractor, and all patching and repairing shall be done by workmen competent in the trade required at the expense of this Contractor. The Contractor shall be responsible for arranging the work so that minimum cutting will be required. All rubbish and excess material involved in such cutting shall be promptly removed from the building and disposed of by this Contractor. Cutting through the floor or roof system shall be done only with approval of the Contracting Officer so as to avoid cutting beams or the structural system. Approval must be obtained from the Contracting Officer before cutting operations begin to avoid damage to the structure. All cutting must be carefully and neatly accomplished so as to minimize noise and dusting or staining of surrounding finishes.

3.8 VALVES

A. The necessary valves shall be installed within the systems to provide required shut-off and flow control service and to allow isolation for inspection, maintenance and repair of each piece of equipment, fixture and each main and branch service loop.

B. Each valve shall be installed so that it is easily accessible for operation, visual inspection and preventative maintenance.

3.9 CLEANING THE PIPING SYSTEMS
A. Before pipe covering is applied and final tests are made, flush the water piping systems thoroughly to remove grit, sand, oil, etc., for as long a time as is required to thoroughly clean the apparatus and piping. Make the required temporary connections for this purpose.

B. Care must be taken not to get dirt, grease, etc., upon the floors or walls. Any damage done shall be promptly repaired.

C. After the period of these operations, any defects or damages that may have developed in the equipment and apparatus as a result of the cleaning process or the operation of the system shall be made good, and the apparatus put in first class working order. Each step of the cleaning process shall be observed by the Contracting Officer.
PART 1 - GENERAL

1.1 WORK INCLUDES

A. Provide pressure tests on plumbing, sanitary waste, and venting piping systems.
B. Provide pressure tests on domestic cold and hot water piping systems.
C. Provide pressure test of natural gas piping.

1.2 RELATED WORK

A. Specified elsewhere:
   1. Division 1 - General Requirements.
   2. Section 15050 - Basic Materials and Methods
   3. Section 15400 - Plumbing

1.3 QUALITY ASSURANCE

A. Notify Contracting Officer three days prior to the tests, who will in turn notify other interested parties.
B. Piping systems where required, shall be pressure tested for leaks in accordance with the Code for Pressure Piping, ANSI B31.1.0, and as specified herein.
C. All tests shall be performed and all piping defects shall be corrected prior to insulating, inaccessible concealing or backfilling. Leaks shall be repaired, all repaired piping shall be retested. All defective pipe, materials and workmanship shall be removed and replaced and tests shall be repeated until systems are proven entirely tight.
D. The tests shall not be performed until piping systems have been flushed and cleaned.

1.4 SUBMITTALS

A. Submit three (3) copies of all testing reports to the Contracting Officer and a copy of each report shall be included in the O & M manual under test reports.

PART 2 - PRODUCTS

2.1 TESTING MATERIALS

A. All materials, pumps, compressors and equipment required for testing shall be provided by the Contractor installing the piping system.
B. Where water is used in hydrostatic testing, only potable water shall be used.

PART 3 - EXECUTION

3.1 TESTING OF PIPING SYSTEM - GENERAL

A. Devices or equipment, or parts thereof, gauges thermometers, etc., which may be damaged by test pressures shall be removed or protected during tests.
B. Fabricated piping shall not be connected to equipment until testing has been completed. Before applying test pressure, provide restraining devices as required to prevent distortion of piping system during testing.
C. Welding and screwed joints and other potential leak sources of the systems to be hydrostatically tested shall be painted with a powdered blue chalk and water mixture and allow to dry before testing begins.

D. All joints in the piping systems shall be inspected during the test period. All defective joints shall be removed, repaired and replaced. Pinning or caulking of leaks will not be permitted.

E. Where air is used for pressure testing, the air pressure shall be gradually applied. All leak sources shall be checked for leaks by applying a coating of soap suds to the source.

F. After tests have been completed and piping systems proven tight, piping and equipment shall be tested for complete drainage through unions, caps, plugs, faucets or hose valves at low points. If piping and equipment do not drain properly, piping and equipment shall be regraded and drain points added until system can be completely drained. Systems shall be left dry in freezing weather.

3.2 PLUMBING, STORM WATER, AND VENTING SYSTEMS

A. Piping systems shall be tested with water or air either in its entirety or in sections. Contractor shall provide all equipment, material, and labor necessary for inspection and tests. Cleanouts, etc. shall be removed to ascertain if the pressure has reached all parts of the system.

B. Water test - if applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a ten foot head of water. In testing successive sections, at least the upper ten feet of the next preceding section shall be tested, so that no joint or pipe in the building (except the uppermost ten feet of the system) shall have been submitted to a test of less than a ten foot head of water. The water shall be kept in the system, or in the portion under test, for at least thirty minutes before inspection starts.

C. Air test shall be made by attaching an air compressor testing apparatus to any suitable opening, and after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gage pressure of five pounds per square inch. The pressure shall be held without introduction of additional air for a period of thirty minutes before inspection starts.

D. System shall be inspected for leaks. In the event leaks are discovered they shall be repaired and tests repeated until system is proven water tight.

3.3 DOMESTIC COLD AND HOT WATER PIPING SYSTEMS

A. Domestic cold and hot water piping shall be hydrostatically tested to a pressure of 100 psig, or 1.5 times the line pressure whichever is greater, registered at ground floor level. Testing shall be considered complete when systems hold the test pressure for a minimum period of one hour without variation in pressure except that which is due to changes in temperature. Comply with local utility requirements.

3.4 NATURAL GAS PIPING

A. Natural gas piping shall be tested in accordance with NFPA-54.
PART 1 - GENERAL

1.1 WORK INCLUDES

A. Provide all materials, equipment, apparatus, services, methods, tools, labor, transportation, etc., required to complete the insulation of the mechanical systems as shown on the drawings and as specified.

B. Cold piping requiring insulation:
   1. Domestic cold water piping.
   2. New PVC drain, waste, and vent piping above lay-in ceilings.
   3. Refrigerant suction piping.
   4. New chilled water piping.
   5. New horizontal storm drain piping.

C. Hot piping requiring insulation:
   1. Domestic hot water, tempered hot water and hot water recirculating piping.
   2. Grease reclaim piping.
   3. Heating hot water piping.

D. Ductwork requiring insulation:
   1. New rigid supply and outside air ductwork.

E. Option Proposal 5: Provide heating hot water piping insulation for new boiler system.

1.2 CODES AND STANDARDS

A. Where applicable, the Fire Hazard Classification of the materials herein specified shall be listed and inspected by Underwriters Laboratories, Inc. The flame spread rating, fuel contributed and smoke developed as shown in the listing shall be determined by ASTM E84 "Method of Tests for Surface Burning Characteristics of Building Materials". Each product shall bear the label of Underwriters’ Laboratories. All products used on this project shall be classified as "non-combustible" in National Building Code or NFPA National Fire Code.

1.3 SUBMITTALS

A. Submit shop drawing in accordance with Section 15010 for all insulation as follows:
   1. Schedule listing each type of insulation, insulation thickness, density, "K" factor, type of jacket, etc., and the service or type of work that the insulation is to apply.

1.4 DEFINITION

A. The term "piping" as used in this section of the specifications shall include pipe, fittings, valves, specialties, strainers, flanges, unions, runouts, final connections, etc.

1.5 PROTECTION

A. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Any such insulation or covering damaged prior to final acceptance of the work shall be satisfactorily repaired or replaced.
B. Provide sturdy metal guards on all duct and pipe insulation subject to damage from normal maintenance operations and personnel.

PART 2 - PRODUCT

2.1 COLD PIPING AND EQUIPMENT INSULATION (DOWN TO 0 F)

A. Minimum 3-1/2 pounds per cubic foot density, fiberglass factory molded or spun pipe insulation with a "K" factor of 0.24 at 75 F mean temperature and a factory applied fire retardant self-sealing vapor barrier jacket.

B. Flexible elastomeric expanded rubber complying with ASTM C 534.

2.2 HOT PIPING INSULATION (UP TO 500 F)

A. Minimum of 3-1/2 pounds per cubic foot density fiberglass, factory molded or spun pipe insulation with a "K" factor of 0.24 at 75 F mean temperature and a factory applied fire retardant self-sealing jacket.

2.3 DUCTWORK INSULATION

A. Blanket: ASTM C 553, Type II, Class F-1, jacketed flexible fiberglass blankets with 0.32 average thermal conductivity at 75 deg F mean temperature.

B. Board: ASTM C612, glass fibers bonded with thermosetting resin, with factory applied FSK jacket.

2.4 INSULATION MANUFACTURERS

A. Manufacturers for insulation products specified above shall be Certain-Teed/Saint Gobain Corp., Owens-Corning Fiberglass Corp., Manville Corp, or Knauf Fiberglass.

B. Manufacturers for flexible foamed plastic insulation shall be Armstrong, Rubatex Corp., or Halstead Industrial Products.

2.5 ADHESIVES, LAGGING, AND SEALERS

A. Adhesives, lagging and sealers shall be as recommended by the insulation manufacturers. Where applicable, they shall include an anti-vermin and fungicidal agent and shall be non-toxic and non-flammable.

B. Manufacturers for adhesives, lagging and sealers shall be Benjamin Foster, Insul-Coustic or Chicago Mastic Co.

2.6 PREMOLDED FITTING AND VALVE COVERS

A. Premolded fitting and valve covers shall be factory made of one piece polyvinyl chloride. Covers shall overlap the adjoining pipe insulation.

B. Manufacturers for fitting and valve covers shall be Insul-Coustic Corp., Zeston, Inc., or Certain-Teed/Saint Gobain Corp.

PART 3 - EXECUTION

3.1 PREPARATION/GENERAL REQUIREMENTS

A. Clean thoroughly to remove rust, plaster, and dirt before insulation is applied. Insulation
shall be applied on clean dry surfaces only. Apply duct and pipe insulation only after systems have been pressure tested and balanced.

B. Insulation work shall be installed by competent applicators regularly employed by insulating contractors or manufacturers.

C. Exposed insulated ducts and piping shall be provided with a finish of an adequate surface for a final coat of paint. Pre-sized jackets, aluminum, vinyl and other pre-finished jackets are acceptable as installed, however, canvas and similar material shall be filled and sealed or dipped if necessary to provide a good surface for painting.

D. Vapor barriers on cold surfaces and piping must be continuous through sleeves, hangers, supports, etc. Stapling of vapor barrier jackets will not be permitted.

E. Provide saddles, shields, metal protectors and other appurtenances necessary to prevent crushing of insulation at hangers, rollers, supports and anchors. Provide rigid insulation blocks at saddles.

3.2 COLD PIPING INSULATION

A. Insulate the following piping systems with cold piping fiberglass insulation of specified thicknesses.

<table>
<thead>
<tr>
<th>Type of System or Pipe</th>
<th>Insulation Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Domestic cold water piping.</td>
<td>1”</td>
</tr>
<tr>
<td>2. New chilled water piping</td>
<td>1-1/2”</td>
</tr>
</tbody>
</table>

B. Installation of fiberglass insulation shall be as follows:

1. Pipe: Butt all joints firmly together. Cover joints with 3” butt strips. Smoothly secure all jacket laps and joints strips with adhesive. Self-sealing laps shall be applied according to manufacturers recommendations. Ends of pipe insulation shall be sealed off with a vapor barrier coating at all fittings and valves and at intervals of 21 feet on continuous runs.

2. Fittings and Valves: Insulate with molded fiberglass fittings, segments of pipe covering or firmly compressed foil faced fiberglass blankets. Secure in place with 20 gauge corrosion resistant wire and a smooth coat of insulating cement. Vapor seal by applying a layer of open weave glass cloth embedded between two coats of vapor barrier mastic. Lap glass cloth 2” onto adjacent pipe insulation. In lieu of glass cloth and two coats of vapor barrier mastic, premolded fitting and valve covers may be used. Covers shall overlap adjoining pipe insulation, have all edges sealed with vapor barrier mastic, and have ends of covers taped with 2” pressure sensitive vinyl tape.

C. Insulate PVC piping above lay-in ceilings with ½” thick elastomeric insulation with joints glued vapor tight.

D. Insulate refrigerant suction piping with ½” thick elastomeric insulation with joints glued vaportight. Insulation exposed to sunlight shall be painted with two coats of ultraviolet resistant paint approved by the manufacturer.

3.3 HOT PIPING INSULATION:

A. Insulate the following piping systems with fiberglass insulation of thicknesses as specified.

<table>
<thead>
<tr>
<th>Type of Service or Pipe</th>
<th>Insulation Thickness</th>
</tr>
</thead>
</table>
1. Domestic hot water 1”
2. Heating hot water 1”
3. Grease reclaim piping 1”

B. Installation of fiberglass insulation shall be as follows:

1. Pipe: Butt all joints firmly together. Cover joints with 3” butt strips. Smoothly secure all jacket laps and joints strips with adhesive. Self-sealing laps shall be applied according to manufacturers recommendations.
2. Fittings and Valves: Insulate with molded fiberglass fittings, segments of pipe covering or firmly compressed foil faced fiberglass blankets. Secure in place with 20 gauge corrosion resistant wire and a smooth coat of insulating cement. Apply a layer of open weave glass cloth embedded between two coats of mastic. Lap glass cloth 2” onto adjacent pipe insulation. In lieu of glass cloth and two coats of mastic, premolded fitting and valve covers may be used.

3.4 DUCTWORK INSULATION

A. Insulate new concealed rigid supply and outside air ductwork with $\frac{3}{4}$ lb density, 2” thick fiberglass blankets with ASJ, with joints sealed vapor tight.

B. Insulate rigid supply, return, and outside air ductwork in mechanical rooms with 3 lb density, 2” thick fiberglass board insulation with joints sealed vapor tight.

C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer’s recommended coverage rates per unit area.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

END 15250
PART 1 - GENERAL

1.1 WORK INCLUDES

A. All piping, fittings, valves, hangers and other accessories specified and shown on the drawings for complete domestic cold, hot water and hot water recirculating piping systems.

B. All piping, fittings, hangers, and other accessories specified and shown on the drawings for a complete sanitary waste and vent piping system including all necessary excavating and backfilling.

C. All roof drains, floor drains and cleanouts specified and shown on the drawings.

D. All piping, fittings and valves specified and shown on the drawings for roughing in and final connection to equipment provided by AAFES.

E. Testing, flushing, and cleaning, for all piping systems and chlorination of the domestic water piping system.

F. All water treatment systems for ice makers, post mix, etc. as specified and shown on the drawings.

G. All backflow preventers required for AAFES furnished drink station equipment, not furnished with the equipment. Coordinate with Installation Manuals provided with equipment.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with current edition of following:

1. Pipe and fittings shall conform to applicable ANSI, AWWA, ASTM, and USASI standards referenced for those products.

B. No plumbing fixture, special equipment, device or piping shall be installed which will provide cross connection or interconnection between distributing supply for drinking water or domestic water and polluted supply or waste so as to make possible backflow or back-siphonage of sewage or polluted water into potable water supply system.

C. Where possibility of back-siphonage exists, water supplied to fixture shall be introduced through a suitable vacuum breaker installed at code minimum distance above fixture.

1.3 SUBMITTALS

A. Submit certificates of compliance for pipe, fittings and valves specified under this section.

B. Submit shop drawings in accordance with Section 15010 for the following equipment:

1. Floor drains.
2. Cleanouts.
3. Hose bibbs.
4. Water treatment systems.
5. Thermostatic mixing valves.

C. Provide all identification, operating instructions, parts lists, wiring and control diagrams for all equipment installed under this section.
D. All items specified in this section shall be manufactured in the United States.

PART 2 - PRODUCTS

2.1 DOMESTIC COLD, HOT WATER AND HOT WATER RECIRCULATING PIPING SYSTEMS

A. See Section 15050 - Basic Materials and Methods for piping materials.

B. Each supply riser and fixture supply, including hot and cold water shall have a separate water hammer arrestor of the same size as the supply pipe line to the fixture. Water hammer arrestors shall be sized per P.D.I. - WH201. Air chambers are not acceptable.

C. All supply connections to plumbing fixtures and equipment shall be copper piping up to face of wall and chromium plated brass piping and fittings for exposed connections. Supply piping shall have screwed connections on both ends for piping through wall. Each fixture shall have a shut off valve at the fixture.

D. Each water connection to a plumbing fixture or item of equipment having a submerged inlet or hose end attached shall be provided with a vacuum breaker to prevent back-siphonage of contaminated water into drinking supply, approved by local and state health authorities.

2.2 SOIL, WASTE, AND VENT PIPING SYSTEMS

A. See Section 15050 - Basic Materials and Methods for piping materials.

2.3 FLOOR DRAINS

A. Unless noted otherwise, floor drains shall conform to the following:

1. Floor drains in slab-on-grade-floors shall not be flashed, shall have black iron bodies with nickel bronze covers and strainers, and must be located to properly serve associated equipment and be accessible for cleaning as approved by the Contracting Officer. Floor drains in floors above grade shall be flashed.

2. Floor drains shall have covers and strainers securely fastened by countersunk, tamperproof, brass machine screws.

3. All floor drains shall have a 6" minimum strainer size. On floor drains larger than 2", strainer size shall be 3" or more larger than the drain size unless specifically shown otherwise on the drawings.

4. Floor drain sizes shall be as shown on the drawings.

B. All floor drains shall be by the same manufacturer. Furnish and install a deep seal "P" trap at each floor drain. See floor drain schedule for model numbers.

C. Manufacturers for floor drains shall be Zurn, JR Smith, Wade, Sioux Chief, or Josam.

2.4 CLEANOUTS

A. All cleanouts shall be by the same manufacturer.

1. See schedule on drawings.

2.5 HOSE BIBBS AND WALL HYDRANTS

A. Hose bibbs shall be 3/4" size, chrome plated, with removable T handle key and vacuum breaker. Chicago Faucet Model No. 952 or equivalent.
B. Wall hydrants shall be ¾” size, chrome plated, recessed with removable T handle key and vacuum breaker. Woodford B67 or equivalent.

2.6 DOMESTIC WATER TREATMENT SYSTEMS FOR FOOD SERVICE

A. Water treatment systems shall be Everpure with pre-coat filters, activation valves, Everguard II low pressure alarms and backplates as scheduled on the drawings.

PART 3 - EXECUTION

3.1 COLD AND HOT WATER PIPING SYSTEM

A. Above grade water piping:

1. Piping shall be run true, parallel with walls, centered in hangers and sleeves, securely supported by hangers or supports independently of connections and sleeves, anchored as required to control movement. Pipe and fittings arranged as called for and as required to permit free, unrestrained, noiseless expansion and contraction and freedom from strain on equipment.

2. All screwed piping shall be carefully cut, reamed, threaded and worked into place with springing, using a small amount of prepared lubricant on the outside threads. Branch connections shall have three elbow spring pieces to allow for movement due to expansion.

3. Valves and unions or flanges shall be suitable located to isolate each unit, branch circuit or section of piping to facilitate maintenance and/or removal of all equipment and apparatus.

4. All piping shall be installed so as to be free to expand without injury to equipment or building.

5. Plumbing water mains must pitch down to drain completely through fixtures or equipment below; provide accessible unions, brass plugs or hose valves at low points.

6. Plumbing water mains must pitch to vent completely through fixtures or equipment above.

7. All risers or down-feed drops shall be firmly supported and blocking done as necessary to prevent hammer due to vibration. Provide drain valves at bottom of risers.

8. Provide water hammer arresters in sizes and locations for domestic water piping systems as recommended by manufacturers to prevent water hammer and noise. Install arresters per manufacturers’ instructions.

3.2 DISINFECTION OF DOMESTIC WATER SYSTEMS WITHIN THE BUILDING

A. General:

1. Before being placed in service and after testing is completed, all potable water piping shall be disinfected as specified herein, in accordance with AWWA Standard C601-54 and as required by the local Health Department codes.

2. Chlorine may be applied by the use of chlorine gas-water mixture, direct chlorine-gas feed or a mixture of calcium hypochlorite and water. If calcium hypochlorite is used, it shall be equivalent to commercial products such as Perchloron, HTH or Maxochlor. The powder shall be mixed with water to form a paste thinned to a slurry and pumped or injected into the lines.

3. If direct chlorine-gas feed is used, it shall be fed with either a solution-feed chlorinator or by a pressure-feed chlorinator.

4. The lines and fixtures shall be flushed thoroughly after chlorination to remove all foreign matter.
5. Injection shall start only when all fixtures are connected and ready for operation.
6. A service cock or riser (3/4" to at least 1-1/4") shall be provided by the Contractor and located at the point of connection to water service. The disinfecting agent shall be injected into and through the system from this cock or riser only.
7. Chlorine, either gas or liquid, or calcium hypochlorite (liquid or powered) shall be used as a disinfecting agent as approved in federal and AWWA procedures.
8. The disinfecting agent shall be injected by a proportioning pump or device through the service cock or riser slowly and continuously at an even rate.
9. All valves shall be fully opened at least four times during injection and the residual checked with orthotolidine solution.
10. When the chlorine residual concentration indicated not less than 50 parts per million at all outlets, all fixtures and water supply valves shall be closed.
11. The residual shall then be retained for a period of not less than eight hours.
12. After retention, the residual upon checking at most outlets, shall not be less than ten parts per million. If less, the disinfection must be repeated as described above.
13. If satisfactory, all fixtures shall be flushed until residual or orthotolidine tests are not greater than the water supply.
14. Contractor shall furnish Contracting Officer or his authorized representative with sterilization report indicating potable water to be safe from contamination. A copy of the sterilization report shall be included in the O & M manuals under test reports and shall be submitted to the Base.

3.3 FLUSHING WATER PIPING

A. After the piping has been chlorinated, each run of pipe shall be thoroughly flushed out so as to remove all foreign matter from the lines. Flushing will ordinarily be done by opening drain valves along the lines.

B. Sufficient flushing water shall be introduced into the mains to produce a velocity of not less than 4 ft. per second, and this flow rate shall be continued until the discharge is clean and clear and does not show evidences of silt or foreign matter when a sample is visually inspected.

3.4 SOIL, WASTE, AND VENT PIPING SYSTEM

A. Size of soil, waste and vent stacks and branch piping shall be as indicated on the drawings, but in no case less than required by the provisions of the applicable codes.

B. Where possible, cast iron sewers and branches shall pitch down 1/4" per foot, but not less than 1%. Branches, arms and connections, shall be sloped 1/4" in 1'-0" where possible and provide with adequate hangers as specified elsewhere.

C. Interior underground, underfloor or on-ground piping, shall be continuously bedded with depressions for hubs on compacted sand or gravel to undisturbed soil for a minimum depth of 6" under pipe.

D. Connections to soil, waste and drain stacks shall be at 45 degrees; those to vent stacks may be at 45 degrees or 90 degrees except vent setbacks shall be connected to 45 degrees to soil, waste or drain stack.

E. Connections to stacks and sewers shall be arranged so that operation of any fixture will not cause fluctuation of water level in traps of other fixtures.

F. All thread joints shall be made up with pipe joint compound applied to male thread only. Threads exposed after joints are made up shall be painted to prevent rust. Teflon tape may be used at Contractor’s option.
G. Junctions of screwed pipe to bell and spigot cast iron shall be made with ring or half coupling screwed to end of galvanized pipe to form spigot end.

H. Junctions in all drainage lines shall be made with "Y" branches or 1/8" bends, unless closeness of connection prevents it, in which case, where direction of flow is from horizontal to vertical, sanitary tees may be used upon the approval of the Contracting Officer or designated representative.

I. Compression joint installation for cast iron soil pipe:
   1. Fold and insert the one piece neoprene rubber gasket into the hub which has been properly cleaned.
   2. Apply gasket lubricant to the spigot and inside of the gasket.
   3. Push, draw or drive the spigot into the gasketed hub with a pulling tool or suitable device.

3.5 STACKS
   A. Stacks shall impose no stress or strain on branches or connections, be plumb and straight and supported at base with 18" x 18" concrete or brick pier to undisturbed soil.
   B. Unless otherwise noted, soil, waste, drain, and vent stacks shall be concealed in walls, pipe chases, pipe shafts, etc., with cleanouts extended to accessible locations.

3.6 VENTING
   A. All plumbing fixtures shall be vented to prevent siphoning of traps. Venting shown on plans is minimum required and vents and vent stacks shall be increased in size and/or number and relocated as required, to prevent trap siphoning and to comply with applicable codes, ordinances, statutes, regulations of all governmental bodies, without increase in contract price.
   B. A vent stack shall be run parallel to each soil or waste stack to receive branch vents from fixtures and traps. Each vent stack shall originate from a soil or waste pipe at its base. Each soil or waste stack and each vent stack shall be carried through the roof. Where possible, soil, waste, or vent stacks shall be combined before passing through the roof so as to have as few roof openings as possible. Pipes running close to walls shall be offset away from such walls before passing through the roof to permit proper flashing. All vent pipes passing through the roof shall be provided with cast iron increasers one size larger than the pipe but in no case less than 4" and shall extend at least 6" above roof.
   C. All horizontal vent pipes shall grade up to meet the requirements of the local and state codes.
   D. Vent risers and branches shall connect to the soil and waste risers above waste of highest fixture.

3.7 ROOF FLASHINGS
   A. All plumbing piping passing through the roof membrane shall be flashed according to the roofing warranty.
   B. Contractor shall insure all such items are properly flashed and made watertight.

3.8 CLEANOUTS
A. Cleanouts for sanitary drainage systems shall be installed not more than 50 feet apart, including the developed length of the cleanout pipe, in horizontal drainage lines of 4 inches diameter or less. Cleanouts shall be not more than 100 feet apart, including the developed length of the cleanout pipe, in horizontal drainage lines of over six inches to ten inches diameter. A cleanout shall be provided at, or no more than four feet above the base of each vertical soil or waste stack and storm water conductor. Cleanouts shall be installed at such other points as may be necessary for adequate rodding out of drainage piping systems. Cleanouts shall be set flush with floor or wall surfaces.

3.9 INSTALLATION OF PLUMBING SPECIALITIES

A. Install all plumbing specialties including but not limited to floor drains, cleanouts, wall hydrants, hose bibs, water treatment systems, thermostatic water temperature controllers, backflow devices and assemblies, interceptors, pumps, regulators, roof drains, water hammer arrestors, etc. in accordance with manufacturers’ instructions and recommendations.

END 15400
PART 1 - GENERAL

1.1 WORK INCLUDES

A. Provide all plumbing fixtures, including supply and waste fittings, stops, trim, brackets, carriers, etc. specified, shown on the drawings and required for complete installation.

B. Provide all piping, fittings, valves, trim, stops, etc. specified, shown on the drawings and required for rough-in and final connection to Equipment furnished by AAFES.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with current edition of the following:
   2. Enameled Iron Fixtures, NBS-CS-CS77.
   3. Plumbing Fixtures (land use), FS-WW-P-541.

B. All items specified in this section shall be manufactured in the United States.

C. No plumbing fixture, special equipment, device or piping shall be installed which will provide cross connection or interconnection between potable water system and polluted water or sewage system so as to make possible backflow or back siphonage of sewage or polluted water into the potable water supply system.

D. Where possibility of back siphonage exists, water supplied to fixture shall in introduced through a suitable vacuum breaker installed at code minimum height.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 15010 for the following:
   1. Plumbing fixtures and trim.
   2. Carriers.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES AND TRIM

A. All fixtures shall be vitreous china, acid resisting enamel cast iron or stainless steel as specified complete with brass piping, fittings, supplies, stops, flush pipes, trim and brackets. Exposed brass piping and fittings shall be chrome plated.

B. Where manufacturer's numbers for a complete assembly are called for, such assembly shall be modified as specified in this section.

C. Fixtures shall have water, drain, waste, soil, vent, and other connections as called for. Each water connection to fixture shall have an air gap or vacuum breaker. Water connection sizes are minimum and must correspond to manufacturer's standards.

D. Carriers for wall hung fixtures shall be selected for the particular fixture, piping arrangement and building conditions prevailing at each location.

E. Where lavatories without legs are specified, each shall be supported on a chair type carrier with concealed arms.
F. Special sinks, where wall hung, shall have equivalent chair carriers specifically designed for the fixture.

G. Plumbing fixtures shall be according to the following schedule. The following manufacturer's model numbers have been used to establish function and quality. Other manufacturers where listed must be equal to manufacturer specified.

H. Where fixtures, faucets, etc. are specified as single source and no other manufacturer is listed, the contractor shall furnish the manufacturer specified.

I. Model numbers are representative only. Incomplete model numbers do not warrant deletion of specific features or requirements contained in the specification.

1. See schedule on drawings.

PART 3 - EXECUTION

3.1 PLUMBING FIXTURES AND TRIM

A. All fixtures shall be set firm and true, connected to all piping services ready for use. Fixtures shall be installed per manufacturer's recommendations. Caulk opening between wall and plumbing fixtures with mildew-resistant, white acrylic-emulsion sealant.

3.2 AAFES FURNISHED EQUIPMENT

A. Provide rough-ins and final connections to all AAFES furnished equipment including shut off valves, piping, traps, etc. necessary to connect up equipment after it has be installed in place.

B. Install all faucets, sinks drains, tailpieces, overflows, traps, etc. furnished loose with all AAFES furnished equipment.

C. All exposed piping readily visible for AAFES furnished equipment shall be chrome plated red brass pipe and fittings. Braces for support of exposed piping shall be chrome plated.

D. Pending installation of AAFES furnished equipment, all service lines shall be suitably capped, plugged and protected. All water lines shall be valved.

E. Furnish vacuum breakers, pressure regulators solenoid valves, traps, piping, etc. as required for installation of equipment.

END 15450
PART 1 – GENERAL

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

1.2 WORK INCLUDES
A. Base Bid: Hot and chilled water piping for new air handling units, coils, and VAV boxes, including accessories.
B. Option Proposal 5: Hot water piping for new boiler, including accessories.

1.3 PERFORMANCE REQUIREMENTS
A. Hydronic Piping components and installation shall be capable of withstanding the following minimum working pressure and temperatures:
   1. Chilled Water Piping: 150 psig at 150 deg F.
   2. Heating Hot Water Piping: 150 psig at 200 deg F.

1.4 SUBMITTALS
A. Product Data for hydronic specialties.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS
A. Drawn-Temper Copper Tubing: ASTM B88, Type L.
B. Wrought-Copper Fittings and Unions: ASME B16.22.
C. Copper Press Fittings: Copper press fittings by Viega, Nibco, or Elkhart.

2.2 JOINING MATERIALS
A. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
B. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver-alloy for joining copper with bronze or steel.

2.3 DI-ELECTRIC FITTINGS
A. Dielectric Unions shall be factory fabricated for 250 psig working pressure at 180 deg F.

2.4 HYDRONIC SPECIALTIES
A. Bronze, Calibrated-Orifice Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by Armstrong, Bell & Gossett, or Taco.
   2. Body: Bronze, ball or plug type with calibrated orifice.
   3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
8. Handle Style: Lever, with memory stop to retain position.
10. Maximum Operating Temperature: 250 deg F.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
4. Inlet Connection: NPS ½.
7. Maximum Operating Temperature: 225 deg F.

C. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and drain connection.
2. End Connections: To coordinate with adjacent piping.
3. Strainer Screen: Perforated stainless steel with 50% free area.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which hydronic piping is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 VALVE APPLICATIONS

A. Install shut-off duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install balancing valves at each branch connection to return main.

C. Install balancing valve in the return piping from each heating or cooling coil.

3.3 PIPING INSTALLATIONS

A. Drawings, plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved by A/E.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to allow valve servicing.

F. Install piping at indicated slopes.
HYRDONIC PIPING

3.4 HANGERS AND SUPPORTS
A. Hangers, support and anchor devices are specified in Section 23 05 29.

3.5 PIPE JOINT CONSTRUCTION
A. Ream ends of pipes and tubes and remove burrs.
B. Remove slag, scale, dirt, and debris from inside and outside of pipe and fittings before assembly.
C. Soldered Joints: Apply flux to tube end. Construct joints according to ASTM B828 or CDA's Copper Tube Handbook," using lead-free solder.
D. Press Joints: Assemble according to instructions provided by manufacturer of press fittings.

3.6 HYDRONIC SPECIALTIES INSTALLATION
A. Install manual air vents at high points in piping, at coils, and elsewhere as indicated.
B. Install balancing valves at locations indicated.

3.7 TERMINAL EQUIPMENT CONNECTIONS
A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
B. Install control valves in accessible locations close to equipment.
C. Install P&T test ports at coil inlet and outlet connections.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints uninsulated and exposed for examination during test.
2. Flush hydronic piping systems with clean water, then remove and clean or replace strainer screens.
3. Isolate equipment from piping. If a valve is used to isolate equipment, it shall be capable of sealing against the test pressure without damage to the valve.
4. Install safety valve, set at pressure nor more than one-third higher than test pressure, to protect against damage by expanding liquid.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as testing medium.
2. While filling system, use vents installed at high points to release air.
3. Isolate expansion tanks and determine that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system’s working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component of the system under test.
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing or replacing components, and repeat test until there are no leaks.
6. Prepare written report.

C. Perform the following before restarting the systems:

1. Open manual valves fully.
2. Inspect air vents and determine if all bleed air completely.

END 15510
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDES

A. Provide complete refrigeration piping systems for HVAC and AFCI ice machines in compliance with this Section and equipment manufacturers’ instructions.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

C. Test Reports: Indicate results of leak test, acid test.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Record exact locations of equipment and refrigeration accessories on record drawings.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this section with minimum 3 years experience.

1.7 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

C. Welders Certification: In accordance with ASME SEC 9.

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

E. All refrigeration work shall be done by certified Technicians in accordance with Federal Register 40CFR, Part 82, subpart F.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Deliver and store piping and specialties in shipping containers with labeling in place.
C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

D. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 - PRODUCTS

2.1 PIPING

A. Copper Tubing: ASTM B280, Type ACR hard drawn or annealed.
   2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

B. Pipe Supports and Anchors:
   1. Conform to MSS SP58, MSS SP69, and MSS SP89.
   2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Adjustable swivel, split ring.
   3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
   4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
   7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
   8. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.2 REFRIGERANT

A. Refrigerant: ASHRAE 34:
   1. R-410A.
   2. Refrigerant used by ice machine(s) furnished by Exchange.

B. Ozone-Depleting Substances:
   1. Class I Substance, as used in this clause, means any substance designated as class 1 by the Environmental Protection Agency (EPA) 40 CFR Part 82, including but not limited to chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform.
   2. Class II Substance, as used in this clause, means any substance designated as class II by EPA (40 CFR Part 82), including but not limited to, hydrochlorofluorocarbons.
   3. As required by 42 USC 7671j (b), (c), and (d) and 40 CFR Part 82, Subpart E, the Contractor shall label products which contain class I or class II ozone depleting substances or are manufactured with a process that uses class I or class II ozone depleting substances, or containers of class I or class II ozone depleting substances, as follows:

   WARNING: Contains (or manufactured with, if applicable) _______________, (a) substance(s) which harm(s) public health and the environment by destroying ozone in the upper atmosphere. The Contractors shall insert the name of the substance(s).

C. Refrigeration Equipment and Air Conditioners: for Contracts for services for maintenance, repair, or disposal of any equipment using class I or class II ozone depleting substances as a refrigerant, such as refrigerators, chillers, freezers, or air conditioners, including motor vehicle air conditioners: The contractor shall comply with the applicable requirements of Sections 608 and 609 of the Clean Air Act (42 USC 7671g, National Recycling and Emission Reduction Program and 7671h, Servicing of Motor Vehicle Air Conditioners) as each or both apply to the contract.

D. Use of Recycled Materials: To the greatest extent practicable, contractor shall use recycled materials and materials and equipment that are recyclable.
2.3 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, solder ends, sight glass, color coded paper moisture indicator and plastic cap; for maximum working pressure of 500 psig, and maximum temperature of 200 degrees F.

2.4 VALVES

A. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psig and maximum temperature of 275 degrees F.

B. Packed Angle Valves:

1. Forged brass, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psig and maximum temperature of 275 degrees F.

C. Ball Valves:

1. Two piece forged brass body with teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psig and maximum temperature of 300 degrees F.

D. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, flared or solder ends, for maximum pressure of 500 psig.

2.5 FILTER-DRIERS

A. Permanent filter driers:

1. Comply with ARI 730.

2.6 SOLENOID VALVES

A. Valve: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psig. Stem shall permit manual operation in case of coil failure.

B. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box.

2.7 EXPANSION VALVES

A. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, adjustable superheat setting, replaceable inlet strainer, with capillary tube and remote sensing bulb.

B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

PART 3 - EXECUTION

3.1 PREPARATION

REFRIGERANT PIPING AND SPECIALTIES  15535-3
A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Pipe Hangers and Supports:
   1. Install in accordance with ASTM B31.5, ASTM F708 and MSS SP89.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   7. Provide copper plated hangers and supports for copper piping.

G. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

H. Provide clearance for installation of insulation and access to valves and fittings.

I. Provide access to concealed valves and fittings. Coordinate size and location of access doors with other trades.

J. Flood piping system with nitrogen when brazing.

K. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

L. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 09.

M. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

N. Install piping in compliance with equipment manufacturer's instructions.

O. Fully charge completed system with refrigerant after testing.

P. Provide electrical connection to solenoid valves. Refer to Division 26.

Q. Install flower cooler and ice machine condenser, and associated piping in compliance with manufacturers requirements.
3.3 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 01.

B. Test refrigeration system in accordance with ASME B31.5.

C. Pressure test system with dry nitrogen to 200 psig. Perform final tests at 27 inches vacuum and 200 psig using electronic leak detector. Test to no leakage.

3.4 SCHEDULES

A. Pipe Hanger Spacing:

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>MAX. HANGER SPACING</th>
<th>HANGER ROD DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>Feet</td>
<td>Inches</td>
</tr>
<tr>
<td>1/2 to 1-1/4</td>
<td>6.5</td>
<td>3/8</td>
</tr>
<tr>
<td>1-1/2 to 2</td>
<td>10</td>
<td>3/8</td>
</tr>
<tr>
<td>2-1/2 to 3</td>
<td>10</td>
<td>1/2</td>
</tr>
</tbody>
</table>

END 15535
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Gas-fired duct furnaces.
B. Type B gas vent systems.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and
   Division 01 Specification Sections.

B. Product Data for each heater including weights, dimensions, metal gages, and data on features and
   components. Include plan and elevation views of units, minimum clearances, and data on ratings
   and capacities.

C. Wiring diagrams from manufacturer for electrically operated units detailing wiring for power and
   control systems and differentiating between manufacturer-installed and field-installed wiring.

D. Maintenance data for heaters to include in the operation and maintenance manual specified in
   Division 01.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed
   and labeled by UL where available.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Duct Furnaces, Gas:
   a. Hastings.
   b. Lennox Industries, Inc.
   d. Reznor/Thomas & Betts.
   e. Sterling Gas-Fired Heating Equipment Div.
   f. Trane Co. (The).

2.2 DUCT FURNACES, ENERGY EFFICIENT

A. Comply with AGA Z83.8, "Gas Unit Heaters."

2. Type of Gas: Natural.

B. Assembly and Wiring: Heaters factory assembled, piped, wired, and tested for 120 VAC.

C. Housing: Steel, with integral motorized vent exhauster and inserts for suspension mounting rods.
1. External Casings and Cabinets: Baked enamel over corrosion-resistant-treated surface.


E. Burners: Cast iron or aluminized steel.

F. Power Venter: 120 VAC with stainless-steel shaft.


2.3 TEMPERATURE CONTROL

A. See Section 23 0900.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install heaters according to manufacturer's written instructions.

B. Install and connect gas-fired heaters and associated fuel and vent features and systems, installed and connected according to NFPA 54, applicable local codes and regulations, and manufacturer's printed installation instructions.

C. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level.

D. Controls: By Section 23 0900.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Gas Piping: Conform to applicable requirements of Division 22 Section "Natural Gas Piping Systems." Connect gas piping to gas train inlet; provide union with sufficient clearance for burner removal and service. Provide AGA-approved flexible units.

B. Extend type B gas vent through roof to vent cap. Flash per roofing instructions.

C. Electrical: Conform to applicable requirements of Division 26 and 27 Sections.

1. Install electrical devices furnished with heaters but not specified to be factory mounted.

D. Connect heaters and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 ADJUSTING AND CLEANING

A. Adjust burner and other unit components for optimum heating performance and efficiency. Adjust heat distribution features, including louvers, vanes, shutters, dampers, and reflectors, to provide optimum heat distribution for objects, personnel, and spaces served.

B. After completing system installation, inspect heaters and associated components. Repair scratches and mars of finish to match original finish. Clean unit internally using methods and materials
recommended by manufacturer.

3.4 COMMISSIONING

A. Startup Services: Provide startup service, as specified below.

1. Start units and operate controls and safeties.
2. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
3. Correct deficiencies identified by tests and observations and retest until specified requirements are met.
PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes split-system air-conditioning units consisting of separate evaporator and compressor-condenser components evaporator coil by 15781.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
   B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
      1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
      2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.
   B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   B. ASHRAE Compliance:
      1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
      2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."

1.7 COORDINATION
   A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
1.8 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:
   a. For Compressor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Carrier.
B. Daikin.
C. Trane.
D. York.

2.2 INDOOR COIL

A. Provided with air handling unit by Section 15781.

2.3 OUTDOOR UNITS (6 TONS (21 kW) OR MORE)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressors: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
   a. Compressor Type: Scroll.
   b. Variable capacity compressor motor (first stage only) with manual-reset high-pressure switch and automatic-reset low-pressure switch.
   c. Refrigerant Charge: R-410A.
   d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Fan: Aluminum-propeller type, directly connected to motor.
5. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 15950.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s).
3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Refrigerant Piping: Comply with Section 15535.

3.3 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. 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.
3. Test and adjust controls and safety. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer’s written instructions.

3.5 DEMONSTRATION

A. Train Owner’s maintenance personnel to adjust, operate, and maintain units.
PART 1 - GENERAL

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

1.2 WORK INCLUDES
A. All materials, equipment, tools, labor, etc. required to complete the installation of the air handling units as shown on the drawings and as specified.

1.3 SUBMITTALS
A. General: Submit the following in accord with Division 01.
B. Product data for selected models, including specialties, accessories; and the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound power ratings.
   3. Motor ratings and electrical characteristics plus motor and fan accessories.
   4. Materials gages and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Coil data.
C. Maintenance data for air handling units, for inclusion in Operation and Maintenance Manual specified in Division 01.

1.4 QUALITY ASSURANCE
A. UL Compliance: Air-handling units and components shall be UL listed and labeled.
B. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.
C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
D. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
E. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, “Central Station Air-Handling Units” and shall be listed and labeled by ARI.

1.5 DELIVERY, STORAGE AND HANDLING
A. Lift and support units with the manufacturer’s designated lifting or supporting points.
B. Disassemble and reassemble units as required for movement into the final location following manufacturer’s written instructions.
C. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.6 SEQUENCING AND SCHEDULING
A. Coordinate the size and location of structural steel support members.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following.

1. Trane.
2. Daikin.
3. Carrier.

2.2 FANS

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

1. Fan Shafts: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan’s class.

C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.


D. Belts: Oil-resistant, nonsparking, and nonstatic.

E. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.

F. Shaft Bearings: Provide type indicated, having a median like "Rating Life" (AFBMA L) of 200,000 calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

2.3 UNIT CASINGS

A. General: Form walls, roofs, and floors with at least two breaks at each joint. Seal all joints with water-resistant sealant. Provide galvanized steel finish. All surfaces in contact with airstream shall comply with ASHRAE 62.1. Casing shall be double wall construction with 18 gage outer wall and 20 gage inner wall.

B. Casing Insulation: 1” thick encased between outside and inside casing. Comply with ASTM C1071, Type I or Type II.

C. Access Panels and Access Doors: Provide same construction as casing. Provide doors with piano hinges and latches with tool free handles. Provide neoprene gaskets. Provide in following locations:

1. Fan Section: Access doors.
2. Coil Section: Access panels.
3. Filter Section: Access door.

D. Condensate Drain Pan: Stainless Steel pan fabricated with two percent slope in at least two directions to direct water toward drain connection. Insulate exterior. Comply with ASHRAE 62.1.

E. Mounting Frame: Formed galvanized steel channels designed for low deflection with integral lifting lugs.

2.4 COIL SECTION
A. General Requirements: Comply with ARI 410. Fabricate to allow removal of coils.

2.5 AIR FILTER SECTION
A. General Requirements: Comply with NFPA 90A. Provide filter holding frames arranged for angular orientation, with access doors on both sides of unit.
B. Filters: Provide MERV 8 disposable fiberglass pleated filters with beverage board frames.

2.6 DAMPERS
A. General Requirements: Provide low leakage parallel blade aluminum dampers rated according to AMCA 500 and complying with UFC 3-420-01.

2.7 WATER AND REFRIGERANT COILS
A. Tubes: Seamless copper, complying with ASTM-B-75, arranged in parallel or staggered pattern, expanded into fins, silver brazed joints, compliant with ARI-410.
B. Fins: Aluminum continuous plate type with full fin collars.
C. Casing: Die formed channel frame of 16 gage galvanized steel. Provide tube supports for coils longer than 48 inches.
D. Water Coil Headers: Cast iron with tubes expanded into header of Seamless copper tube with silver brazed joints.
E. Refrigerant Coils: Provide heaters and distributors for even flow of refrigerant thru coil.
F. Water Coils Configuration: Drainable, with threaded plugs in headers for drain and vent.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fans.
B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL
A. Install unit level and plumb, in accordance with manufacturer's written instructions.
B. Arrange installation of units to provide access space around air handling units for service and maintenance.

3.3 CONNECTIONS
A. Duct installations and connections are specified in other Division 15 sections. Make final duct connections with flexible connections.
B. Pipe Connections: See section 15510 and 15535.
C. Electrical Connections: The following requirements apply:
   1. Electrical power wiring is specified in Division 16.
   2. Temperature control wiring and interlock wiring are specified in Section 15950.
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.4 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust damper linkages for proper damper operation.

C. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

END 15781
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Provide packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories, where specified

1. Direct-expansion cooling.
2. Heat pump heating with electric back-up heat.
3. Economizer outdoor- and return-air damper section with factory mounted controller and sensors.
4. Roof curbs.
5. Programmable thermostat.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

D. Supply-Air Fan: The fan providing supply air to conditioned space. “Supply air” is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

E. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations. “Supply air” is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 SUBMITTALS

A. Comply with Division 1.

B. Product Data: Include manufacturer’s technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

C. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals. Comply with Division 1.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.


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

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:
   1. Daikin.
   2. Trane.
   4. Carrier.

2.2 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
   1. Provide hinged access panels for filter, controls, and fan motor access. Panels shall be operable without tools.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

C. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
   1. Materials: ASTM C 1071, Type I.
   2. Thickness: 1 inch.
   3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
   4. Liner Adhesive: Comply with ASTM C 916, Type I.
D. Condensate Drain Pans: Formed sections of coated galvanized steel sheet, or other corrosion resistant rigid material, a minimum of 2 inches (50 mm) deep, and complying with ASHRAE 62.1.

1. Drain Connections: Threaded nipple.

E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.3 FANS

A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

2.4 COILS

A. Supply-Air Refrigerant Coil:

1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type distributor.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: Two on units larger than 6 tons.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

C. Refrigeration Specialties:

1. Refrigerant: 410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
5. Automatic-reset low-pressure safety switch.
8. Brass service valves installed in compressor suction and liquid lines.

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

2. Depth: 2” pleated disposable.

2.7 ELECTRIC HEATING COIL

A. Description: Manufacturer’s standard nickel-chromium electric heating coil with integral safety.
2.8 DAMPERS

A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to operating rod or gear train in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor and Economizer controller: Provide factory mounted sensors, controller and actuator to provide dry bulb economizer control.
2. Relief-Air Damper: Gravity actuated or motorized, as scheduled, with bird screen and hood.

2.9 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.10 CONTROLS

A. Provide programmable thermostat.

2.11 ACCESSORIES

A. Hail guards of galvanized steel, painted to match casing.
B. Roof Curb: Full perimeter sheet metal curb with wood nailer; neoprene sealing strips, and internal insulation, designed and constructed to allow new unit to sit on existing roof and connect to new supply and return duct connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
B. Examine roughing-in for RTUs to verify actual locations of piping and curb dimensions before equipment installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install curb level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:
   1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 CLEANING AND ADJUSTING

A. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.6 DEMONSTRATION

A. Train Owner maintenance personnel to adjust, operate, and maintain rooftop air handling units.

END 15782
PART 1 - GENERAL

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

1.2 WORK INCLUDES
A. Sheet metal ductwork for air distribution systems including accessories.
B. Duct liner for return air ductwork.

1.3 QUALITY ASSURANCE
A. Codes and Standards:
   1. SMACNA Standards: Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
B. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

1.4 SUBMITTALS
A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products in accord with Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS
A. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality; with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations.
B. Carbon Steel Sheets: Comply with ASTM A 1008A/A 1008M.
C. Exposed round ductwork shall be spiral seam construction.
D. Stainless Steel Sheets: Comply with ASTM A408A or 480M, type 304 or 316.
2.2 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 degree change of direction per section. Unless specifically detailed otherwise, use 45 degree laterals and 45 degree elbows for branch takeoff connections. Where 90 degree branches are indicated, provide conical type tees.

C. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.

D. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

E. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

2.3 FABRICATION

A. Shop fabricate ductwork in 4, 8, 10 or 12-ft. lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

B. Shop fabricate ductwork of gages and reinforcement complying with SMACNA “HVAC Duct Construction Standards”.

C. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 deg. for contracting tapers and 20 deg. for expanding tapers.

D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division 23 section "Ductwork Accessories" for accessory requirements.


1. Dishwasher hood ductwork shall be constructed of 24 gage stainless steel with watertight joints.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, “Fibrous Glass Duct Liner Standard.”

1. Type II liner by Certainteed, Owens-Corning, or Knauf, or Johns Manville.

2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by and NRTL and registered by the EPA for use in HVAC system.

3. Water Based Lined Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
a. For indoor applications, adhesive shall have VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper or zinc-coated steel ping, fully annealed for capacitor-discharge welding, length to suit depth of insulation indicated with integral 1-1/2 inch galvanized carbon-steel washer.
2. Insulation-Retaining washers: Self-locking washers with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible,” Figure 7-11, “Flexible Duct Liner Installation.”

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or “Z” profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transvers joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32 inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF METAL DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3” and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install
each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

C. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

D. Penetrations: Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.

   1. When ducts pass through fire-rated floors, walls, or partitions, provide firestopping between duct and substrate, in accordance with requirements of SMACNA.

E. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

F. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.


3.3 EQUIPMENT CONNECTIONS

A. General: Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.4 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Flexible ducts.
   2. Flexible connectors.
   3. Duct accessory hardware.

B. Related Sections include the following:
   1. Division 15 Section "Diffusers, Registers, and Grilles."

1.3 SUBMITTALS

A. Product Data: For the following:
   3. Flexible ducts.
   4. Flexible connectors.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA standards:
   1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
   2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.

C. Aluminum Sheets: ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view and mill finish for concealed ducts.


E. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 FLEXIBLE CONNECTORS

A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.

   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.

2.3 FLEXIBLE DUCTS

A. General: Comply with UL 181, Class 1.

B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch thick, glass-fiber insulation around a continuous inner liner.
   2. Inner Liner: Polyethylene film.

C. Pressure Rating: 6-inch wg positive, 1/2-inch wg negative.

2.4 ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.

B. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size.

C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

B. Install volume dampers as indicated on plans.

C. Provide test holes at fan inlet and outlet and elsewhere as indicated.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

END 15820
PART 1 - GENERAL

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

1.2 SUMMARY
   A. Provide:
      1. Complete Food Service Ventilating systems including canopy, filters, lights,
         ductwork, extinguishing system, and control panels for exhaust fans.
      2. Extinguishing system may be factory installed or field fabricated.

1.3 QUALITY ASSURANCE
   A. Regulatory Requirements:
      1. National Fire Protection Association, NFPA:
         c. 17A: Wet Chemical Extinguishing Systems.
      2. National Sanitary Foundation, NSF:
         a. Seal of approval.
      3. Underwriter's Laboratories, UL:
         a. UL listed and labeled components.

1.4 SUBMITTALS
   A. Submit in accordance with 01340.
   B. Product Data:
      1. Submit manufacturer’s product data and installation instructions.
   C. Shop Drawings:
      1. Submit layout of entire extinguishing system including nozzles, piping, and fused
         links.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
   A. Exhaust Hoods:
      1. Halton (Charley’s)
         a. No substitution.
      2. Captiveaire.
   B. Extinguishing System:
      1. Ansul.
2.2 CANOPY HOODS:

A. Construction:
   1. 18 gauge stainless steel, Type 304.
   2. Canopy internal supports consisting of angles and channels to reinforce and prevent vibration and fatigue.
   3. Canopy fabricated as one piece and shipped as one piece.

B. Filter:
   1. Canopy filter housing of same material as canopy liner, complete with UL classified extractor type aluminum grease filters full length.
   2. Filter shall provide constant pressure drop.
   3. Filter housing shall terminate at bottom with pitched drip tray full length of canopy and shall be equipped with grease cup for easy removal and daily cleaning.
   4. Filter shall be large enough for air to strike it at all temperatures.

C. Lights:
   1. Vapor-proof lights with plastic coated glass lens spaced on 3 foot centers, where scheduled and wired to J-box on top of canopy; provide bulb for fixture.

D. Extinguishing System:
   1. System shall protect range hoods, exhaust ducts, filters and appliances.
   2. Automatic operation initiated by fusible metallic links with temperature ratings in accordance with below referenced installation manual.
   3. Piping:
      a. Pipe: Standard weight, Schedule 40; black steel; chrome-sleeved where exposed.
      b. Fittings: Malleable-iron, ductile-iron, steel or cast-iron; of standard weight.
      c. Pipe reamed and cleaned before assembly and after assembly.
   4. Provide manual release station, located as indicated on drawings, for each extinguishing system. Provide permanent plastic laminate tag at each pull station, clearly indicating hood served.
   5. Provide set of dry contacts for contacts for fire alarm system.

E. Controls:
   1. Provide packaged exhaust fan controls in compliance with International Mechanical Code to start fans when cooking equipment is placed in operation. Provide digital output to controls by section 15950 to start make-up air units.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which exhaust hoods are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HOODS

A. Install hoods and extinguishing systems as indicated on Drawings and in accord with NFPA 96 and 17A.

B. Provide all miscellaneous framing, anchors, and brackets necessary to properly support hoods.
C. Install piping and extinguishing systems in compliance with manufacturers requirements and recommendations.

D. Install remote mounted sensors and wiring as required for hood controls in compliance with Division 16.

3.3 FIELD QUALITY CONTROL

A. Start-Up:

1. Provide start-up supervision.
2. Provide instruction to AAFES Personnel on system operation.
3. Provide field certification by system manufacturer.
4. Provide acceptance test observed by Base Fire Department personnel. Test extinguishing system in conjunction with fire alarm tests. Contractor to provide all material and labor to conduct the test(s).

END 15825
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections include the following:
   1. Division 15 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
   2. Division 15 Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

1.3 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.4 SUBMITTALS

A. Product Data: For each model indicated, include the following:
   1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
   2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
   3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
   4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Acceptable manufacturers:
   1. Krueger.
2. Titus.

B. Diffusers, registers, and grilles are scheduled on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Provide exhaust fans as shown on the drawings and as specified.

1.3 SUBMITTALS

A. General: Submit the following in accord with Division 1.

B. Product data for selected models, including specialties, accessories; and the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound power ratings.
   3. Motor ratings and electrical characteristics plus motor and fan accessories.
   4. Materials gages and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.

C. Maintenance data for fans, for inclusion in Operation and Maintenance Manual specified in Division 1.

1.4 QUALITY ASSURANCE

A. UL Compliance: Fans and components shall be UL listed and labeled.

B. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.5 DELIVERY, STORAGE AND HANDLING

A. Lift and support units with the manufacturer's designated lifting or supporting points.

B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

C. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate the installation of adapter curbs with Division 7.

B. Coordinate the size and location of structural steel support members.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Subject to compliance with requirements, provide products by one of the following.
   1. Cook (Loren) Co.
   2. Greenheck Fan Corp.

2.2 FANS, GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
   1. Fan Shafts: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

D. Belts: Oil-resistant, nonsparking, and nonstatic.

E. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
   1. Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.

F. Shaft Bearings: Provide type indicated, having a median like "Rating Life" (AFBMA L) of 200,000 calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

2.3 CENTRIFUGAL ROOF VENTILATORS

A. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.

B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venture inlet cone.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
   1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   4. Fan and motor isolated from exhaust airstream.

E. Accessories:
   1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
   2. Bird Screens: Removable, ½ inch mesh, aluminum or brass wire.
   3. Dampers: Counterbalanced, parallel blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.
   4. Roof Curbs: Prefabricated galvanized steel curbs with internal insulation.
   5. Accessories to meet NFPA-96 as scheduled.
      a. Include curb extensions as required to locate fan discharge minimum of 40” above roof deck.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fans.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units as described below, using the vibration control devices indicated.
   1. Secure roof-mounted fans to roof curbs with stainless steel hardware.

B. Arrange installation of units to provide access space around air handling units for service and maintenance.

3.3 CONNECTIONS

A. Duct installations and connections are specified in other Division 15 sections. Make final duct connections with flexible connections.

B. Electrical Connections: The following requirements apply:
   1. Electrical power wiring is specified in Division 16.
   2. Temperature control wiring and interlock wiring are specified in Section 15950.
   3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.4 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust damper linkages for proper damper operation.

B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

END 15872
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDES
A. Provide as herein specified, modification and extension of the existing Carrier Comfort Network Direct Digital Control (DDC) temperature control system and electric control subsystems. The control systems shall be installed by competent control technicians. The control system shall consist of all sensors controllers, damper operators, switches, control panels, and other accessory equipment along with a complete system of electrical wiring to fill the intent of the specification and provide for a complete and operable system. All control equipment shall be fully proportioning, except as otherwise noted.

B. Interlock wiring between hood exhaust fans and new and existing air handling units.

C. Interlock wiring for new toilet and barber shop exhaust fans.

D. New controls for new air handling units.

E. Relocation and reconnection of the existing air handling unit controller and chilled water control valve.

F. Relocation and reconnection of existing room temperature sensors.

G. Revisions to controls for existing air handling units AHU-6 and AHU-7.

1.2 SUBMITTALS
A. The contractor shall submit copies of complete temperature control diagrams with written "sequence of control" and factory printed specification data sheets, covering each control device proposed to be used, for engineer's approval, prior to installation of any equipment or part of system.

1.3 MANUFACTURERS
A. Carrier.

PART 2 - PRODUCT

2.1 MATERIALS AND EQUIPMENT
A. General: Provide DDC and electric control products in sizes and capacities indicated, consisting of thermostats, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer. Provide electric control systems with the following functional and construction features as indicated.

B. Air Handling Unit Controls:
   1. The system shall be reconfigured to provide control, monitoring and communication of the following information:
      a. Analog Input Points
1. Outside air temperature.
2. Supply air temperature.
3. Return air temperature.
4. Supply temperature setpoint.
5. Duct differential pressure.

b. Binary Input Points
   1. Supply fan on/off status.
   2. Supply fan failure.
   3. Dirty filter.

c. Analog Output Points
   1. Outside air return air and relief air damper position.
   2. Supply fan speed.
   3. Cooling coil valve position (AHU-1).
   4. Heating coil valve position (AHU-1).

d. Binary Output Points
   1. Fan on/off.
   2. Interlocked toilet exhaust fan.
   3. Four cooling stages (AHU-2).
   4. Two heating stages (AHU-2).

2. The system control panel shall provide the following control functions for each unit.
   a. Schedule unit for optimum start and provide a program that automatically adjusts on a daily basis the morning start-up time based on the zone temperature versus the occupied setpoint and the historical recovery rate for each unit.

3. New room temperature sensors shall have timed over-ride button and setpoint adjustment. Room temperature readout shall be concealed.

C. Actuators:

1. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
   a. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
   b. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   c. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
   d. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   e. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

2. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
   a. Valves: Size for torque required for valve close off at maximum pump differential pressure.
   b. Dampers: Size for running torque calculated as follows:
      1. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
      2. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
damper.
4. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
5. Dampers with 2 to 3 Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque of 1.5.
6. Dampers with 3 to 4 Inch wg of Pressure Drop of face Velocities of 2500 to 3000 fpm: Increase running torque of 2.0.

c. Coupling: V-bolt and V-shaped, toothed cradle.
d. Overload-Protection: Electronic overload or digital rotation-sensing circuitry.
e. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.

E. Dampers:
1. Mixing dampers for existing air handling units shall remain.
2. Mixing dampers for new air handling units provided with units.

PART 3 - EXECUTION

3.1 INSPECTION
A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF CONTROL SYSTEMS
A. General: Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division-16 sections of these specifications. Mount controllers at convenient locations and heights.

B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.

C. Wiring System: Install complete control wiring system for control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly. Install room temperature sensors on j-boxes; run rigid conduit in walls to above ceilings for control wiring. Control wiring above ceilings may be run open if neatly tie-wrapped to structure.

D. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.

3.3 SEQUENCE OF OPERATION
A. HVAC System Supply Fan Operating:
1. Interlocked exhaust fans shall be stopped in the unoccupied mode and their dampers shall be closed. Interlocked exhaust fans shall run in the occupied mode, and their dampers shall open. Heating and cooling controls shall function as described hereinafter for the specific modes of operation. Outside air dampers shall be open to minimum position unless in economizer mode.
B. HVAC System Supply Fan Not Operating:

1. When an HVAC system is stopped, all interlocked fans shall stop. Outside air and relief air dampers shall close. Return air damper shall open.

C. Constant Volume Unit (AHU-1 and AHU-2):

1. Occupied and Unoccupied Modes of Operation:
   a. At the time programmed, the controller shall place the system in the occupied mode. At the programmed time the controller shall place the control system in the unoccupied mode of operation. Outside air damper shall open to minimum position in occupied mode. Outside air damper shall be closed, return air dampers open in unoccupied mode. Relief dampers shall be controlled by same signal as outside air dampers.

2. Supply Fan Control:
   a. Occupied Mode - supply fan shall start and operate continuously.
   b. Unoccupied Mode - The supply fan shall cycle based on the night setpoints and the temperature at the night sensor. The fan shall start at and stop at the setpoints programmed.
   c. Current sensor shall monitor fan operation.

3. Filter:
   a. A differential pressure switch across the filter banks shall turn on the filter alarm when the pressure drop across the filter banks reaches the setpoint.

4. Cooling Control:
   a. Constant volume unit:
      1) Occupied Mode - The cooling coil valve or DX cooling stages shall be controlled by the DDC controller to maintain space temperature setpoint. Provide four cooling stages for AHU-2.
      2) Unoccupied Mode – Same as occupied mode.
      3) Provide comparative enthalpy economizer control as first stage of cooling.

5. Heating Control:
   a. Constant volume unit:
      1) Occupied Mode – Electric heat stages (existing unit) heating coil valve (AHU-1) or duct furnace stages (AHU-2) shall be controlled by the DDC controller to maintain space temperature setpoint.
      2) Unoccupied Mode – Same as occupied mode.
      3) Provide low temperature control for AHU-1 such that if space temperature does not increase within 30 minutes after a call for heating, the outside air damper shall be closed. Damper shall open again after space temperature returns to normal range.

D. Interlocked Toilet Exhaust Fans (E-1 and E-11 with existing AHU-7; E-2 with relocated AHU):

1. Occupied Mode – fans run continuously.
2. Ventilation Delay and Unoccupied Modes – fans off.

E. Interlock with Hood Exhaust Fans (E-3, 4, 5, 6, 7, 8, and 9):

1. When any hood exhaust fan is started, AHU-2 and relocated air handling unit shall be placed in occupied mode.

3.4 EXISTING MALL AIR HANDLING UNITS

A. Revise existing CCN controls to control new outside airflow measuring stations and existing return air dampers. Revise existing AHU-7 control outputs to operate new variable frequency
drive in lieu of existing inlet vanes.

3.5 EQUIPMENT LABELING

A. Labels shall be installed wherever necessary to clarify functions of components and facilitate adjustment and servicing. Labels shall be required on, but not limited to the following:

1. Control panels.
2. Automatic damper motors.
3. Temperature sensors.

3.6 FINAL ADJUSTMENT OF CONTROLS

A. After completion of the installation, adjust all thermostats, control valves, motors and other equipment provided under this contract and place them in complete operating condition.
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The HVAC systems will be tested and balanced by an independent testing and balancing (TAB) agency under separate contract with AAFES.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.1 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS

The HVAC systems will be tested and balanced by an independent testing and balancing agency that is certified by AABC or NEBB.

A. The independent air testing and balancing agency (TAB) shall perform the balancing and testing of the HVAC in accordance with the procedures of AABC or NEBB to analyze, balance, adjust and test air and water moving equipment, air and water distribution systems including kitchen exhaust hood systems.

B. The HVAC Contractor shall put all heating, ventilating and air conditioning systems and equipment into operation and shall continue the operation of same during each working day of testing and balance and shall place the automatic temperature control system in satisfactory operation before the TAB agency shall begin work.

C. Prior to the final acceptance of the HVAC systems by the Contracting Officer, the Contractor shall allow the TAB agency to schedule this work in cooperation with other trades involved and comply with the completion date of the project.

D. The Contractor shall make available to the TAB agency a complete copy of shop drawing submittal data on mechanical equipment including performance curves (fans and pumps, chillers, air distribution devices, etc.) necessary to test and balance the HVAC systems.

E. The Contractor shall schedule the following necessary personnel:

1. Automatic Temperature Control Manufacturer's Service Representative to set adjustments of automatic operated damper and devices to operate as specified, and/or noted, including setting of all controls for proper calibrations.

2. Mechanics - To operate, adjust, replace or repair the HVAC equipment that is found requiring any change/replacement in the pulleys, belts, dampers, valves, etc., of Contractors furnished and installed equipment.

3. Electrician - To assist in any problems resulting from any of the power or control wiring installation, including replacement of starters, and heater elements.

F. The Contractor shall make any changes in pulleys, belts and dampers or the addition of dampers as required for correct balance of the system as recommended by TAB agency, at no cost to Owner/Government.

G. The Contractor shall make all necessary corrections within 48 hours upon notification of TAB agency of the deficiencies requiring adjustment, (piece-meal correction is not acceptable) and within 10 working days for items that require replacement or installation.

H. The Contractor shall leave all strainers clean and all air filters replaced prior to the start of testing and balancing activity.
I. If the Contractor had scheduled the TAB agency to perform the work and the HVAC systems are not ready to be tested and balanced, any additional cost required to extend the TAB work shall be at the Contractor's expense.

END 15990
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior demolition, removal and abandonment of interior electrical systems, including communications and special systems including fire alarm and telephone.

B. Cleaning and repair of existing equipment to remain.

1.2 RELATED SECTIONS

A. Division 01 - Selective Demolition.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Contracting Officer before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

E. Contractor shall verify and or test ballasts, transformers, and other devices or equipment to be removed do not contain and PCB or other hazardous materials requiring special disposal. Contractor is responsible for all testing and disposal costs.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages with Store Manager, Project Manager and Base minimum of 14 days in advance of outage. All outages shall occur during non-customer hours with power being restored a minimum of two hours prior to beginning of next business day.

C. Provide temporary wiring and connections to maintain existing systems in other areas during all phases of construction.

D. Existing Electrical Service: Existing services will remain. Disable electrical service only to make switchovers and connections. Obtain permission from store manager and base at least 14 days before partially or completely disabling system. Minimize outage duration to the fullest extent possible. Make temporary connections to maintain service in areas adjacent to work area. Outages shall only occur during non-customer hours. Service shall be restored a minimum of 2 hours prior to the start of customer hours.

E. Existing Telephone System: Maintain existing system. Disable system only to make switchovers and connections. Notify Contracting Officer and Network Enterprise Center (NEC).
at least 10 days before partially or completely disabling system. Minimize outage duration to fullest extent possible. Outage shall occur during non-customer hours. Make temporary connections to maintain service in areas adjacent to work area. Outages shall only occur during non-customer hours. Service shall be restored a minimum of 2 hours prior to the start of customer hours.

F. Existing Intrusion Detection System: Existing system shall remain in service. Disable system only to make switchovers and connections. Obtain permission from the Contracting Officer and Provost Marshall at least 10 days before partially or completely disabling system. Minimize outage duration to fullest extent possible. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION EXISTING ELECTRICAL WORK

A. Demolish existing electrical work under provisions of Division 01, and this Section.

B. Remove existing installations to accommodate requirements for new construction.

C. Remove abandoned wiring to source of supply or next active device to remain.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

F. Disconnect and completely remove abandoned panelboards, distribution equipment, feeders branch circuit wiring and conduits. Where conduits in slab remain; remove wiring to allow grinding and grouting of conduit flush with adjacent surface. Remove under slab conduits as required to coordinate with new work. Cut and patch floor slab as required.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition work.

J. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

K. Support existing conduits, boxes and cables above ceilings or on walls to be removed if those systems are existing to remain.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide new typed circuit directory showing revised circuiting arrangement.

END 16060
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal conduit.
B. Flexible metal conduit.
C. Liquidtight flexible metal conduit.
D. Electrical metallic tubing.
E. Nonmetallic conduit.
F. Flexible nonmetallic conduit.
G. Fittings and conduit bodies.

1.2 RELATED SECTIONS

A. Division 07 – Roofing Pen penetrations.
B. Division 07 – Firestopping.
C. Section 16130 – Boxes.
D. Section 16170 – Grounding and Bonding.
E. Section 16190 – Supporting Devices.
F. Section 16195 – Electrical Identification.

1.3 REFERENCES

A. Conduit and tubing shall meet the requirements of the latest editions of following standards:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
3. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
5. NECA "Standard of Installation."
6. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70. Limit conductor cross sectional area to no more than 40% of conduit cross sectional area.

1.5 SUBMITTALS

A. Submit under provisions of Division 01 – Submittals.
B. Product Data: Provide for metallic conduit, flexible metal conduit, liquid tight flexible metal conduit, metallic tubing, nonmetallic conduit, fittings, conduit bodies.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 – Project Record Documents.

B. Accurately record actual routing of interior conduits larger than 2 inches on project record documents and of all underground conduits regardless of size. For locations of underground conduits provide dimensions indicating locations and depth.

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept conduit on site. Inspect for damage.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

C. Protect PVC conduit from sunlight.

1.9 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown schematically on Drawings unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

A. Minimum Size: ¾” inch unless otherwise specified.

B. Underground Installations:

1. More than Five Feet outside Foundation Wall: Use rigid steel conduit, intermediate metal conduit, plastic coated rigid steel conduit or thickwall nonmetallic (Schedule 40 PVC) conduit.

2. Within Five Feet Inside Foundation Wall: Use rigid steel conduit, intermediate metal conduit, plastic coated rigid steel conduit or thickwall nonmetallic (Schedule 40 PVC) conduit.

3. Under Slab on Grade: Use rigid steel conduit, intermediate metal conduit, plastic coated rigid steel conduit or thickwall nonmetallic (Schedule 40 PVC) conduit.

C. Outdoor Locations, Above Grade: Use rigid steel or intermediate metal conduit.

D. Wet and Damp Interior Locations Above Floor Slab: Use rigid steel conduit, intermediate metal conduit or electrical metallic tubing. Use wet and/or damp location fittings.
E. Dry Interior Locations Above Floor Slab (Including Hollow Stud Partitions):
   1. Concealed: Use rigid steel, intermediate metal conduit or electrical metallic tubing.
   2. Exposed: Use rigid steel, intermediate metal conduit or electrical metallic tubing.

2.2 METAL CONDUIT
   A. Rigid Steel Conduit: ANSI C80.1.
   B. Intermediate Metal Conduit (IMC): Rigid steel.
   C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit, threaded connections.

2.3 PVC COATED METAL CONDUIT
   A. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.
   B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.4 FLEXIBLE METAL CONDUIT
   A. Description: Interlocked steel construction.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT
   A. Description: Interlocked steel construction with PVC jacket.

2.6 ELECTRICAL METALLIC TUBING (EMT)
   A. Description: ANSI C80.3; galvanized tubing.
   B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel compression type or set screw type.

2.7 NONMETALLIC CONDUIT
   A. Description: NEMA TC 2; Schedule 40 PVC.
   B. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install conduit in accordance with NECA "Standard of Installation" and NFPA 70.
   B. Install nonmetallic conduit in accordance with manufacturer's instructions and NFPA 70.
   C. Provide supports as required by NEC maximum distance between conduit support tables. Arrange supports to prevent misalignment during wiring installation.
D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers. Where possible, support conduits in ceiling cavity space at the level of structural roof joists.

E. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each rack for 25 percent additional conduits.

F. Fasten conduit supports to building structure and surfaces under provisions of Section 16190. DO NOT SUPPORT CONDUITS DIRECTLY FROM ROOF DECK.

G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

H. Do not attach conduit to ceiling support wires. Fasten individual conduits to roof joists.

I. Arrange conduit to maintain headroom and present neat appearance.

J. Route exposed conduit parallel and perpendicular to walls. Where exposed conduits are required, paint conduits to match surrounding surfaces.

K. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

L. Route conduit under slab directly from point-to-point where possible. Avoid conduit crossovers where possible.

M. Do not install conduit in floor slab on grade or floor slab above grade. Run conduits 1-1/2" and below on grade at bottom of gravel sub-base. Conduits larger than 1-1/2" shall be trenched in below grade so top of conduit is at top of grade.

N. Maintain minimum 6-inch clearance between conduit and piping.

O. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

P. Cut conduit square using saw or pipe cutter; de-burr cut ends before joining.

Q. Bring conduit to shoulder of fittings; fasten securely.

R. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 10 minutes, minimum. Use only an approved hotbox bender to make bends in nonmetallic conduit.

S. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

T. Install no more than equivalent of three 90-degree bends between boxes (no more than two 90-degree bends for conduits containing telephone cables, fire alarm cables, intrusions system cables, local area network (LAN) cables, etc.). Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than 2-inch size.

U. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

V. Provide expansion/deflection couplings to accommodate expansion and deflection where conduit crosses seismic joints or expansion joints. Such couplings shall have braided copper bonding jumpers.
W. Provide suitable pull string in each empty conduit except sleeves less than 20 feet long and nipples.

X. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

Y. Ground and bond conduit under provisions of Section 16170.

Z. Identify conduit under provisions of Section 16195.

AA. Where conduits for telephone cables, cash register cables, etc. are stubbed from wall boxes or cabinets to above accessible ceilings, turn conduits out of wall approximately 12 inches above accessible ceiling. Coordinate location with other trades. Provide bushing on end of conduit to prevent signal cable contact with sharp metal. Provide tag on end of conduit indicating type and location of utilization outlet (example: TELEPHONE - BREAK ROOM).

BB. In interior locations, turn nonmetallic conduits through floor slab using rigid steel elbows. Continue raceway above floor slab using metallic conduit.

CC. Where conduits turn up into large utilization equipment, provide grounding bushings on ends of conduits, and bond to equipment grounding terminal strip or lugs using bonding jumper sized according to NFPA 70.

DD. Where conduits enter boxes and cabinets, provide bushings with plastic insulated throat for conduits 1 inch and larger.

EE. Seismic Bracing: provide seismic bracing for suspended conduits 2" or larger and trapeze hangers at interval of 20 feet or less. Bracing shall consist of 1-5/8" square channel both parallel and perpendicular to conduit and fastened to roof joist at 45-degree angle relative to vertical.

FF. AC and MC cable shall be acceptable for use on this project as specified in Section 16150 and 16123.

GG. Paint exposed conduit to match adjacent surface.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 07.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Building wire and cable.
B. Wiring connectors and connections.

1.2 REFERENCES
A. NECA Standard of Installation (National Electrical Contractors Association).
C. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW
A. Division 01 - Submittals: Procedures for submittals.
B. Product Data: Provide for each cable type.

1.4 SUBMITTALS FOR INFORMATION
A. Division 01 – Submittals: Procedures for submittals.
B. Test Reports: Indicate procedures and values obtained.
C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT
A. Division 01 – Project Record Documents.
B. Project Record Documents: Record actual locations of components and circuits.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS
A. Conform to NFPA 70.
B. Furnish building wire and wiring connectors listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 PROJECT CONDITIONS
A. Verify that field measurements are as indicated.
B. Conductor sizes are based on copper.
C. Wire and cable routing indicated is schematic unless dimensioned.
1.9 COORDINATION

A. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Description: Single conductor insulated wire.

B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: NFPA 70, Type THHN-2/THWN-2.

E. Use standard color coding for phase A, phase B, phase C, neutral and ground: Insulation:
   1. 208/120-volt circuits: black, red, blue, white, green.
   2. 480277-volt circuits: brown, orange, yellow, grey, green with white stripe.

2.2 METAL CLAD (MC) CABLE INSTALLATIONS

A. Type MC cable installation shall be in accordance with the following: No more than six (6) total current-carrying conductors in multiple MC cable runs shall be bundled together into a single MC cable hanger dedicated “POWER”. Wireway or ladder type tray with dual supports may also be used to support MC cable with fill as allowed by the NEC. Neutrals shall be counted as current-carrying conductors. Do not utilize communications tray for branch circuit supports.

B. MC cable shall only be run parallel or perpendicular to walls. No diagonal runs shall be permitted. MC cable shall only be run between a branch circuit distribution box located in the space and the device being served. Conduit and wire shall type installation shall be installed from the panel to the distribution box. MC cables shall not be acceptable in exposed locations.

C. Maintain a clearance of a least 6 inches from hot water and other high-temperature pipes and telecommunications conduits, and at least 12 inches from unshielded twisted-pair telecommunications cables.

D. The arrangement of MC cables and fastening methods shall be subject to the approval of the Architect and Engineer. Securely support all MC cable with cable hangers, individual spring steel support clips, steel trapeze hangers, threaded rods or dedicated No. 8 AWG drop wires. Cable supports shall be fastened to concrete slabs, beams, joists or other structural members of the building. Do not support MC cable on hung ceilings or on ceiling support wires.

E. Support MC cable every 4 feet and within 1 foot of every box, fitting, or cable termination.

F. All MC cables, passing through fire-rated walls or electrical/telecommunications room wall shall be provided with a UL listed, fire-rated penetration assembly.

G. Install cable to preserve fire resistance rating of partitions and other elements, using UL listed materials and methods.

H. All conduit shall be run concealed in walls or above ceilings. It shall not be used in poured concrete walls, floors, or roofs; CMU walls; in earth; or where subject to physical damage.
I. Use standard color coding for phase A, phase B, phase C, neutral, and ground.
   1. 120/208-volt circuits: black, red, blue, white, green.
   2. 277/480-volt circuits: brown, orange, yellow, gray, green.

J. Cables run down walls shall terminate in junction box before making equipment connection in liquid tight whip.

K. MC cable installation shall only be used for 20A and 30A branch circuits.

L. Minimum wire size shall be No. 12 AWG regardless of use. See Section 16111.

M. Provide anti-short bushings at all termination points to prevent wire contact with sharp metal.

M. MC cables shall be run horizontally above ceilings and vertically in wall voids. No horizontal runs with-in wall voids shall be allowed.

N. MC cables shall not be run out of panelboard directly. Provide conduit to above ceiling and then transition to MC cable in accessible space.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that interior of building has been protected from weather.
   B. Verify that mechanical work likely to damage wire and cable has been completed.
   C. Verify that raceway installation is complete and supported.

3.2 PREPARATION
   A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS
   A. Use wiring methods indicated.
   B. All branch circuit and feeder wiring shall be installed in raceways.

3.4 INSTALLATION
   A. Route wire and cable as required to meet Project Conditions.
   B. Install cable in accordance with the NECA "Standard of Installation" and NFPA 70.
   C. Use solid conductors for #12 and smaller, stranded conductors #10 and larger.
   D. Use stranded conductors for power circuits.
   E. Use stranded conductors for control circuits.
   F. Use conductor not smaller than 12 AWG for power and lighting circuits.
   G. Use conductor not smaller than 14 AWG for fused control circuits.
   H. Unless a larger size is indicated on plans, use 10 AWG conductors for 20 ampere, 120-volt branch circuits with homeruns longer than 75 feet.
I. Unless a larger size is indicated on plans, use 10 AWG conductors for 20 ampere, 277-volt branch circuits with homeruns longer than 200 feet.

J. Pull all conductors into raceway at same time.

K. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

L. Neatly train and lace wiring inside boxes, equipment, and panelboards.

M. Clean conductor surfaces before installing lugs and connectors.

N. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

O. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

P. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

Q. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

R. Identify and color code wire and cable under provisions of Section 16195. Identify each conductor with its circuit number or other designation indicated.

3.5 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

3.6 INSULATION RESISTANCE TESTS

A. Perform tests after cables have been installed in raceways, but before connection to lugs. Notify Contracting Officer at least 14 days prior to cable tests.

B. Measure resistance line-to-ground using a commercial megger tester. Apply 1000 volts DC to cables 2 AWG and larger and record DC insulation resistance for each circuit conductor. Minimum acceptable level is 50 megohms.

C. Record test results and include in O and M manual.

END 16123
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Wall and ceiling outlet boxes.
   B. Floor boxes.
   C. Pull and junction boxes.

1.2 REFERENCES
   A. NECA - Standard of Installation.
   B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
   C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
   D. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
   D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   E. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS
   A. Submittals under provisions of Division 01 – Submittals.
   B. Product Data: Provide dimensions, materials, and accessories.

1.4 SUBMITTALS FOR CLOSEOUT
   A. Division 01 – Project Record and Closeout Documents.
   B. Record actual locations and mounting heights of outlet, pull, and junction boxes on project
      record documents.

1.5 REGULATORY REQUIREMENTS
   A. Conform to requirements of NFPA 70.
   B. Provide Products listed and classified by Underwriters Laboratories, Inc., as suitable for
      the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 OUTLET BOXES
   A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
      1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment
         supported; include male fixture studs where required.
      2. Concrete Ceiling Boxes: Concrete type.
   B. Cast Boxes: NEMA FB 1, Type FD, cast ferroalloy. Provide gasketed cover by box
      manufacturer. Provide threaded hubs.
C. Wall Plates for Finished Areas: As specified in Section 16141.

D. Weatherproof exterior boxes to house receptacles: Receptacle shall be installed flush with the wall. The cast aluminum receptacle cover shall have ports to allow two 3/8" diameter cords to pass through and must not protrude over 4-1/2" from wall surface. Enclosure must have gasket between enclosure and mounting surface to assure that the enclosure is weathertight in use per NEC 410-57b. Hubbell WP-700, or equal.

2.2 FLOOR BOXES

A. Floor Boxes: NEMA OS 1, fully adjustable 3.75 inches deep.

B. Material: Cast metal.

C. Shape: Rectangular or round.

D. Service Fittings: As specified in Section 16141.

2.3 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Hinged Enclosures: As specified in Section 16160.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 6; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify locations of floor boxes and outlets prior to rough-in. Where available, use dimensional data to locate boxes.

3.2 INSTALLATION

A. Install boxes in accordance with NECA "Standard of Installation."

B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

C. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet if required to accommodate intended purpose.

E. Orient boxes to accommodate wiring devices as specified in Section 16141.

F. Maintain headroom and present neat mechanical appearance.

G. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

I. Install boxes to preserve fire resistance rating of partitions and other elements.

J. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

K. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

L. Unless otherwise indicated on plans, align adjacent wall mounted outlet boxes for switches, manual starters, interval timers, thermostats, and similar devices. Align wall mounted boxes for receptacles, telephone jacks, local area network outlets, and the like. Where such devices are shown in close proximity on plans, locate adjacent outlets with no more than 4-inch space between adjacent boxes.

M. Use flush mounting outlet boxes in all areas except mechanical rooms, mezzanines, and electrical closets.

N. Unless otherwise indicated on plans, locate flush mounting boxes in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

O. Do not install flush mounting boxes back-to-back in walls; provide minimum 6 inches separation.

P. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. After finished wall material is applied, provide box extensions for all boxes with setback more than 1/8 inch.

Q. Use stamped steel bridges to fasten flush mounting outlet box between studs.

R. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

S. Use adjustable steel channel fasteners for hung ceiling outlet box.

T. **DO NOT FASTEN BOXES TO CEILING SUPPORT WIRES OR DIRECTLY TO ROOF DECK.**

U. Support boxes independently of conduit.

V. Use gang box where more than one device is mounted together. Do not use sectional box. Provide metal barrier plates between gangs to separate line voltage from low voltage systems and where voltage between adjacent light switches exceeds 300 volts.

W. Use 4” square box with plaster ring for single device outlets.

X. Use cast outlet box in exterior locations exposed to the weather, interiors of walk-in refrigeration equipment, and wet locations. Provide vapor seals at conduit entrances to these boxes. Use U.L. listed sealing compound.

Y. Use cast floor boxes for installations in slab on grade.

Z. Set floor boxes level. Recheck level and elevation immediately after concrete pour and rough finish. Where floor boxes for power, telephone, and intrusion detection system occur together, insure these boxes are spaced so as to be completely covered by store fixtures.
AA. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

BB. Provide pull boxes in feeder circuits as required but at least every 150 feet in straight runs.

CC. Identify all junction boxes by panel and circuit number on outside cover with legible permanent ink marker on outside face of cover.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Coordinate installation of outlet box for equipment connected to allow accessibility of box and proper operation of equipment.

3.4 ADJUSTING

A. Adjust floor box so that covers will be flush with finish flooring material.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused box openings.

D. Seal floor boxes as recommended by manufacturer.

3.5 CLEANING

A. Division 01 – Cleaning: Clean installed work.

B. Clean interior of boxes to remove dust, debris, and other material.

C. Clean exposed surfaces and restore finish.

D. Check boxes for the presence of drywall screws, concrete residue, and other sharp objects. Remove all sharp objects.

E. Clean floor boxes and underfloor conduit systems of water and dirt prior to installing wiring. Close boxes to prevent entry of dirt and water after installing wires. Failure to meet this requirement will result in contractor being required to remove wiring, clean boxes and conduit systems and reinstallation of new wiring, all at no cost to Owner.

END 16130
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Wall switches.
B. Receptacles.
C. Device plates and decorative box covers.
D. Floor box service fittings.

1.2 REFERENCES
A. NECA - Standard of Installation.
B. NEMA WD 1 - General Requirements for Wiring Devices.
C. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
D. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW
A. Division 01 - Submittals: Procedures for submittals.
B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.4 SUBMITTALS FOR INFORMATION
A. Division 01 - Submittals: Submittals for information.
B. Submit manufacturer's installation instructions.

1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS
A. Conform to requirements of NFPA 70.
B. Provide Products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 WALL SWITCHES
A. Manufacturers:
   1. Hubbell
   2. Pass & Seymour
   3. Leviton
   4. G.E.
B. Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch. Provide single pole, double pole, three-way, four-way, pilot light, or momentary contact type as indicated.

C. Body and Handle: Plastic with toggle handle.

D. Indicator Light: Separate pilot strap; red lens.

E. Ratings:
   1. Voltage: 120-277 volts, AC.

F. For control of mechanically held contactors or relays; provide three position, momentary contact switches with spring return to center off position. Momentary contact switches shall be rated 120/277 volt, 20 amperes.

G. Color: Architect shall select from manufacturers standard colors. Note: Architect may choose multiple colors throughout project.

2.2 RECEPTACLES

A. Manufacturers:
   1. Hubbell
   2. Pass & Seymour
   3. Leviton
   4. G.E.

B. Description: NEMA WD 1, heavy duty, specification grade receptacle. In barber shop and beauty shop waiting area, provide safety type receptacles which shall discourage insertion of foreign object into receptacle by small children.

C. Device Body: Nylon.

D. Configuration: NEMA WD 6, type as specified and indicated.

E. Convenience Receptacle: Type 5-20.

F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements. Devices shall utilize "Lock Out" technology to ensure outlet cannot be used if ground fault protection fails. Device shall have status LED.

G. Color: Architect shall select from manufacturers standard colors. Note: Architect may choose multiple colors throughout project.

2.3 WALL PLATES

A. Decorative Cover Plate: Smooth nylon in all areas except food prep. Devices in food prep shall be stainless steel. Manufacturer same as device manufacturer. Color to match device.

B. Exterior Wall Weatherproof exterior boxes to house receptacles: Receptacle shall be installed flush with the wall. The cast aluminum receptacle cover shall have ports to allow two 3/8" diameter cords to pass through and must not protrude over 4-1/2" from wall surface. Enclosure must have gasket between enclosure and mounting surface to assure that the enclosure is "Weather proof while in use. The enclosure shall UL Listed. Provide Hubbell WP-700, or equal.
2.4 FLOOR MOUNTED SERVICE FITTINGS

A. Manufacturers:
   1. Hubbell
   2. Pass & Seymour
   3. Leviton
   4. G.E.

B. Flush Cover Convenience Receptacle:
   1. NEMA 5-20R, gray receptacles.
   3. Configuration: Two 1-1/2” dia. screw openings.
   4. Threaded screw cover.
   5. Split nozzle cable protector.

C. Flush Cover Communication Outlet:
   1. Material: Brass.
   2. Configuration: Two 1-1/2” dia. threaded openings.
   3. Threaded screw cover.
   4. Split nozzle cable protector.

D. Flush Cover Combination Fitting:
   1. Material: Brass.
   2. Configuration: Duplex opening with two 1-1/2” threaded openings.
   3. Two threaded screw covers.
   4. Two split nozzle cable protectors.

E. Protective Ring: Brass finish.

F. Split Nozzle: Brass finish.

G. Carpet Ring: Brass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that outlet boxes are installed at proper height.

B. Verify that wall openings are neatly cut and will be completely covered by wall plates.

C. Verify that floor boxes are adjusted properly to ensure covers will be flush with floor covering.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes.

3.3 INSTALLATION
A. Install in accordance with NECA "Standard of Installation."
B. Install devices plumb and level.
C. Install switches with OFF position down.
D. Install receptacles with grounding pole on top.
E. After connecting wires to GFCI receptacles, wrap terminals with four layers of electrician's tape.
F. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
G. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
H. Connect wiring devices by wrapping conductor around screw terminal when using solid conductors. Provide crimp on lugs for terminations when using stranded conductors.
I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas and above accessible ceilings.
J. Install split nozzle on active flush cover service fittings. Turn spares over to Contracting Officer. Obtain hand receipt showing number transferred and include with O and M manual.
K. Install floor box cover plates flush and level with floor covering.
L. Provide ½" black on clear adhesive label tape on each device cover plate centered between the top of the cover and device indicating panel and branch circuit number. This label will be in addition to any label required to indicate loads controlled when multiple light switches are located next to each other (i.e. A-21).

3.4 INTERFACE WITH OTHER PRODUCTS
A. Coordinate locations of outlet boxes provided under Section 16130 to obtain mounting heights indicated on drawings.
B. Coordinate the installation of wiring devices with underfloor duct service fittings provided under Section 16113.

3.5 FIELD QUALITY CONTROL
A. Inspect each wiring device for defects.
B. Operate each wall switch with circuit energized and verify proper operation.
C. Verify that each receptacle device is energized.
D. Test each receptacle device for proper polarity.
E. Test each GFCI receptacle device for proper operation.

3.6 CLEANING
A. Division 01 – Project Record and Closeout Documents: Clean installed work.
B. Clean exposed surfaces to remove splatters and restore finish.

END 16141
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Prefabricated flexible cable assemblies.
   B. Distribution units.
   C. Cable accessories.

1.2 REFERENCES

1.3 SUBMITTALS
   A. Submit under provisions of Division 01 – Submittals.
   B. Shop Drawings: Indicate distribution box, switch box, outlet, and cable layout and branch circuit configuration.
   C. Product Data: Provide for each cable type and for each fitting and accessory.
   D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.
   E. Provide voltage drop calculation showing wire size will support use per NEC guidelines.
   F. Provide scaled drawings showing connection and cable requirements. Electronic drawing files may be obtained by General Contractor from engineer's office (618-242-0473). Request drawings minimum two weeks prior to need.

1.4 PROJECT RECORD DOCUMENTS
   A. Submit under provisions of Division 01 – Project Record and Closeout Documents.
   B. Record actual locations of cable assemblies and branch circuit arrangements.

1.5 OPERATION AND MAINTENANCE DATA
   A. Submit under provisions of Division 01 – Project Record and Closeout Documents.
   B. Maintenance Data: Include replacement parts list.

1.6 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years experience.

1.7 REGULATORY REQUIREMENTS
   A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.8 FIELD MEASUREMENTS
A. Verify that field measurements are as indicated on shop drawings.

1.9 COORDINATION
A. Furnish luminaire connectors to luminaire manufacturer for factory installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. AMP Inc.
B. Hubbell Wiring Devices
C. Siemens Co.
D. Light Fixture Manufacturer.

2.2 MANUFACTURED WIRING SYSTEMS
A. Cable Assemblies: Factory assembled units with appropriate connector on each end, with lengths and circuit configurations as required.
B. Voltage: 120 or 277 volts.
C. Switching Unit Assemblies: Cable assembly with 6-inch pigtail on one end. Provide cables configured for 3-way and 4-way switches where required.
D. Luminaire Connector Assemblies: Connector suitable for mounting in luminaire body knockout. At Contractor’s option, provide connector factory mounted in luminaire.
E. Accessories: Provide manufacturer’s standard accessories, including cable extenders, distribution tees, and switching assemblies.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install Products in accordance with manufacturer's instructions.
B. Support cable by means of straps and clamps independently of ceiling suspension system.
C. Support cable minimum 24” above suspended ceiling to avoid contact with and interference with removal of ceiling panels.
D. Arrange cable to avoid interference with access to other work.

END 16150
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Grounding electrodes and conductors.
   B. Equipment grounding conductors.
   C. Bonding.

1.2 REFERENCES
   B. NFPA 70 - National Electrical Code.

1.3 GROUNDING SYSTEM DESCRIPTION
   A. Metal underground water pipe.
   B. Effectively grounded metal frame of the building.
   C. Rod electrode.
   D. Concrete encased electrode.

1.4 PERFORMANCE REQUIREMENTS
   A. Grounding System Resistance: 5 ohms maximum.

1.5 SUBMITTALS FOR REVIEW
   A. Division 01 – Submittals: Procedures for submittals.
   B. Product Data: Provide for grounding electrodes and connections.

1.6 SUBMITTALS FOR INFORMATION
   A. Division 01 - Submittals: Submittals for information.
   B. Test Reports: Indicate overall resistance to ground.
   C. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.7 SUBMITTALS FOR CLOSEOUT
   A. Division 01 – Project Record and Closeout Documents: Procedures for submittals.
   B. Record actual locations of components and grounding electrodes.

1.8 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.9 REGULATORY REQUIREMENTS
A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories, Inc.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES
A. Material: Copper-clad steel.
B. Diameter: 3/4 inch.
C. Length: 10 feet.

2.2 MECHANICAL CONNECTORS
A. Manufacturers: Burndy or approved equal.
B. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS
A. Manufacturers: Cadweld or approved equal.

2.4 WIRE
A. Material: Stranded copper. Unless noted otherwise, provide with green insulation.
B. Size: As required by NEC.

2.5 GROUND BUSHING/LUG
A. Insulated metallic grounding bushings, tin-plated open-type lug dual rated for CU-AL conductors, thermoplastic liners rated 105-degree C, die cast zinc, to provide a smooth, well-rounded bearing surface for wires or cable at the end of threaded conduit or a conduit connector as required by the NEC.

2.6 ISOLATED GROUNDING CONDUCTORS
A. Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor at both ends of conductors and at any boxes or splice locations with alternating bands of green and yellow tape. Provide at least three bands of green and two bands of yellow tape.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION
A. Install rod electrodes at exterior of building near service equipment. Install additional rod electrodes as required to achieve specified resistance to ground.

B. Provide 3/0 AWG bare copper grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together using tie wires so there is a minimum of 40 feet of continuous bar to which to bond grounding electrode conductor.

C. Provide 3/0 AWG bare copper grounding electrode conductor and connect to metal cold water pipe. Metal cold water pipe must be in continuous direct contact with the earth a minimum of 10 feet. Make connection a maximum of 5 feet from the point of entrance to the building.

D. Provide bonding to meet Regulatory Requirements.

E. In addition to bonded equipment grounding conductors, provide isolated grounding conductors for circuits shown on plans. Conductors shall be 12 AWG unless noted otherwise and one per circuit.

F. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

G. Where multiple ground terminal strips are provided with new panels, run solid bare #8AWG between all ground terminal strips.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.13.

C. Maximum acceptable resistance to ground shall be 5 ohms.
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Conduit and equipment supports.
B. Anchors and fasteners.

1.2 REFERENCES
A. NECA - National Electrical Contractors Association.

1.3 SUBMITTALS
A. Submit under provisions of Division 01 – Submittals.
B. Product Data: Provide manufacturer's catalog data for fastening systems.
C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS
A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS
A. Materials and Finishes: Provide adequate corrosion resistance.
B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
C. Anchors and Fasteners:
   1. Concrete Structural Elements: Use precast insert system or expansion anchors and preset inserts.
   2. Steel Structural Elements: Use beam clamps or welded fasteners.
   5. Solid Masonry Walls: Use expansion anchors and preset inserts.

2.2 STEEL CHANNEL
A. Manufacturer: Unistrut (P1000 unless otherwise noted) or approved equal.
B. Description: Galvanized or painted steel. (1-5/8” square.)
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation", NFPA 70 and maximum distance between conduit support tables.

C. Do not fasten supports to pipes, ducts, mechanical equipment, ceiling support wires, and conduit.

D. Do not use spring steel clips and clamps.

E. Do not use powder-actuated anchors.

F. Do not drill or cut structural members.

G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

H. Install surface-mounted cabinets and panelboards with minimum of four anchors.

I. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.

J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END 16190
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Nameplates.
B. Wire and cable markers.
C. Conduit markers.

1.2 REFERENCES

1.3 SUBMITTALS
A. Submit under provisions of Division 01 – Submittals.
B. Product Data: Provide catalog data for nameplates, labels, and markers.
C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.4 REGULATORY REQUIREMENTS
A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 NAMEPLATES
A. Nameplates: Engraved three-layer laminated plastic, white letters on black background. Screw on type with two self tapping screws. Mastic type nameplates not allowed.
B. Locations:

1. Main disconnect switch (indicate maximum allowable fuse size where fuse is smaller than switch ampere rating).
2. Each switch in switchboard.
3. Each lighting and appliance panelboard.
4. Each breaker in distribution panel.
7. Relays and contactors. Indicate loads controlled.
8. Time switches. Indicate load controlled.
10. Where more than two switches are located adjacent to each other or where switches control loads not in same space.
11. Where noted on plans.
C. **Letter Size:**

1. Use 1/8-inch letters for identifying individual equipment and loads such as safety switches, motor starters, and relays.
2. Use 1/4-inch letters for identifying grouped equipment and loads such as panelboards, switchboards, and motor control centers.

### 2.2 WIRE MARKERS

A. **Description:** Cloth, tape, split sleeve, or tubing type wire markers.

B. **Locations:** Each conductor at distribution equipment panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.

C. **Legend:**

   1. Power and Lighting Circuits: Branch circuit or feeder circuit number.
   2. Control Circuits: Control wire number corresponding to applicable control schematics.

### 2.3 CONDUIT MARKERS

A. **Location:** Conduit couplings and junction box covers shall be painted to indicate system that conduit serves.

B. **Color:**

   1. 480 Volt System: Orange.
   2. 208 Volt System: Natural conduit.
   5. Emergency: Red
   6. Comm/Data: Blue

### 2.4 COVER PLATES

A. Install floor box cover plates flush and level with floor covering.

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**PART 3 - EXECUTION**

### 3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates.

### 3.2 APPLICATION

A. Install nameplate parallel to equipment lines.

B. Secure nameplate to equipment front using screws.

C. Identify conduit using field painting under provisions of Section 09910.

D. Field paint colored couplings on each conduit longer than 6 feet and conduit stubs.

E. **Color:**

   1. 480 Volt System: Orange
   2. 208 Volt System: Natural conduit.
5. Emergency: Red
6. Comm/Data: Blue

F. Identify underground conduits using underground warning tape. Install one tape per trench at 12" inches above conduits or duct bank.

END 16195
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Pad mounted switchboards.
B. Switchboard accessories.

1.2 RELATED SECTIONS
A. Division 03 - Cast-in-Place Concrete: Concrete for supporting foundations and pads.
B. Section 16170 - Grounding and Bonding.
C. Section 16685 – Transient Voltage Surge Suppressor (TVSS).

1.3 REFERENCES
A. NEMA AB 1 - Molded Case Circuit Breakers.
B. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
C. NEMA PB 2 - Dead Front Distribution Switchboards.
D. NEMA PB 2.1 - Instructions for Safe Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
C. NEMA 260 - Safety Labels for Padmounted Switchgear and Transformers Sited in Public Areas.
E. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW
A. Division 01 – Submittals: Procedures for submittals.
B. Product Data: Provide electrical characteristics including voltage and ampere ratings, fault current withstanding ratings, and time-current curves of all equipment and components.
C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details.

1.5 SUBMITTALS FOR INFORMATION
A. Division 01 – Submittals: Submittals for information.
B. Test Reports: Indicate results of factory production tests.
C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 SUBMITTALS FOR CLOSEOUT
A. Division 01 – Project Record and Closeout Documents: Submittals for project closeout.

B. Record actual locations of switchboard in project record documents.

C. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated. Provide UL service equipment listing and labeling.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.10 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.11 MAINTENANCE MATERIALS

A. Division 01 – Project Record and Closeout Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General Electric.

B. Siemens.

C. Square D.

D. Cutler Hammer.

2.2 FOOD COURT SWITCHBOARD

A. Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated and specified.

B. Ratings:

1. Voltage: 120/208 volt.
2. Configuration: Three phase, four wire, grounded.
3. Main Bus: As indicated on riser diagram.
4. Integrated Equipment Rating: 200,000 rms amperes symmetrical.

C. Main Section Devices: 100% Rated circuit breaker.
Distribution Section Devices: Individually mounted and compartmented.

Auxiliary Section Devices: Individually mounted and compartmented.

Bus Material: Copper, standard size.

Bus Connections: Bolted, accessible from front only for maintenance.

Fully insulate load side bus bars in rear accessible compartments. Do not reduce spacing of insulated bus.

Ground Bus: Extend length of switchboard.

Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials and sizes indicated.

Ground Fault Sensor: Zero sequence type.

Pull Section: 36-inch-wide, depth and height to match switchboard. Arrange with pull section on right side of switchboard as viewed from the front. See power plans and riser diagram.


Enclosure: Type 1 - General Purpose.

1. Align sections at front and rear.
2. Switchboard Height: 90 inches, excluding floor sills, lifting members and pull boxes.
3. Finish: Manufacturer’s standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint or plate with cadmium or zinc.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide concrete housekeeping pad under the provisions of Section 03300. Provide 6” high pad with 6” x 6” continuous wire mesh at vertical center of pad. Extend pad 6” beyond front and sides of switchboard. Provide 1-inch x 45-degree chamfer at front and side edges.

3.2 INSTALLATION

A. Install switchboard in locations shown on Drawings, according to NEMA PB 2.1.
B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
C. Provide sheet metal barriers to seal any void around equipment if not tight to walls. Gauge and color to match equipment.
D. Provide and install arc flash warning signs per NEC 110.16.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.
B. Perform inspections and tests listed in NETA ATS, Section 7.1.

3.4 ADJUSTING

A. Division 01 – Project Record and Closeout Documents: Adjusting installed work.

DISTRIBUTION SWITCHBOARD 16426-3
B. Adjust all operating mechanisms for free mechanical movement.

C. Tighten bolted bus connections in accordance with manufacturer's instructions.

3.5 CLEANING

A. Division 01 – Cleaning: Cleaning installed work.

B. Touch up scratched or marred surfaces to match original finish.

C. Clean dust and debris from interior and exterior of switchboard.

END 16426
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Fusible switches.
B. Non-fusible switches.

1.2 REFERENCES
A. NECA - Standard of Installation (published by the National Electrical Contractors Association).
B. NEMA FU1 - Low Voltage Cartridge Fuses.
C. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
E. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW
A. Division 01 – Submittals: Procedures for submittals.
B. Product Data: Provide switch ratings and enclosure dimensions.

1.4 SUBMITTALS FOR CLOSEOUT
A. Division 01 – Project Record and Closeout Documents: Submittals for project closeout.
B. Record actual locations of enclosed switches in project record documents.

1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS
A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. General Electric.
B. Siemens.
C. Square D.
D. Cutler Hammer.
2.2 FUSIBLE SWITCH ASSEMBLIES
   A. Description: NEMA KS 1, Type HD, enclosed load interrupter knife switch. Handle lockable in OFF position.
   B. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses. Provide rejection clips to prevent the use of other than Class R fuses.

2.3 NONFUSIBLE SWITCH ASSEMBLIES
   A. Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.

2.4 ENCLOSURES
   A. Fabrication: NEMA KS 1.
      1. Interior Dry Locations: Type 1.
      2. Exterior Locations: Type 3R.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install in accordance with NECA "Standard of Installation."
   B. Install fuses in fusible disconnect switches with fuse labels visible from fronts of enclosures.
   C. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.
   D. Provide engraved nameplates for switches not in sight of controlled loads. Indicate load type and location and correct fuse size for fusible switches.

3.2 FIELD QUALITY CONTROL
   A. Inspect and test in accordance with NETA ATS, except Section 4.
   B. Perform inspections and tests listed in NETA ATS, Section 7.5.

3.3 CLEANING
   A. Division 01 – Cleaning: Clean installed work.
   B. Touch up scratched or marred surfaces to match original finishes.
   C. Clean dust and debris from interior and exterior of cabinet.

END16441
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Two-winding transformers.

1.2 RELATED SECTIONS
A. Division 03 – Cast-In-Place Concrete: Concrete for supporting foundations and pads.
B. Section 16111 – Raceways.
C. Section 16170 – Grounding and Bonding.

1.3 REFERENCES
A. NEMA ST 1 - Specialty Transformers (Except General-Purpose Type).
B. NEMA ST 20 - Dry-Type Transformers for General Applications.
C. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW
A. Division 01 – Submittals: Procedures for submittals.
B. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.5 SUBMITTALS FOR INFORMATION
A. Division 01 – Submittals: Submittals for information.
B. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.
C. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 SUBMITTALS FOR CLOSEOUT
A. Division 01 – Project Record and Closeout Documents: Submittals for project closeout.
B. Record actual locations of transformers in project record documents.

1.7 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS
A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

A. Manufacturers:

1. General Electric.
2. Siemens.
3. Square D.
5. Cooper.

B. Description: NEMA ST 20, factory-assembled, air cooled, copper winding dry type transformers, ratings as indicated.

C. Primary Voltage: 480 volts, 3 phase.

D. Secondary Voltage: 208Y/120 volts, 3 phase.

E. Insulation system and average winding temperature rise for rated kVA as follows:

1. 1-15 kVA: Class 185 with 80 degrees C rise.
2. 16-500 kVA: Class 220 with 80 degrees C rise.

F. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.

G. Winding Taps:

1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

H. Sound Levels: NEMA ST 20.

I. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

J. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

K. Mounting:
1. 1-15 kVA: Suitable for wall or trapeze mounting.
2. 16-75 kVA: Suitable for wall or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor or trapeze mounting.

L. Coil Conductors: Continuous windings with terminations brazed or welded.
M. Enclosure: NEMA ST 20, Type 1 ventilated. Provide lifting eyes or brackets.
N. Isolate core and coil from enclosure using vibration-absorbing mounts.
O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 SOURCE QUALITY CONTROL
A. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Set transformers plumb and level. Hold transformers minimum of 6 inches from walls.
B. Use flexible conduit, under the provisions of Section 16111, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
C. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
D. Mount floor-mounted transformers on concrete pads. Provide 4" high pad with 6" x 6" continuous wire mesh at vertical center of pad. Extend pad 6" beyond front and sides of transformer. Provide 1-inch x 45-degree chamfer at front and side edges.
E. Mount trapeze-mounted transformers as indicated.
F. Provide seismic restraints. Provide lateral and longitudinal bracing using 1-5/8" square steel channel.
G. Provide grounding and bonding in accordance with Section 16170.
H. Provide 4" thick concrete equipment pad for all floor mounted transformers. Pad shall be 6" larger than width and depth on all sides.

3.2 FIELD QUALITY CONTROL
A. Inspect and test in accordance with NETA ATS, except Section 4.
B. Perform inspections and tests listed in NETA ATS, Section 7.2.

3.3 ADJUSTING
A. Measure primary and secondary voltages and make appropriate tap adjustments.

3.4 CLEANING
A. Division 01 – Cleaning: Clean installed work.
B. Touch up scratched or marred surfaces to match original finishes.
C. Clean dust and debris from interior and exterior of transformer according to manufacturer’s instructions.

END 16461
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Distribution panelboards.
B. Branch circuit panelboards.

1.2 RELATED SECTIONS
A. Section 16170 – Grounding and Bonding.
B. Section 16195 – Electrical Identification.
C. Section 16685 – Transient Voltage Surge Suppressor (TVSS).

1.3 REFERENCES
A. NECA Standard of Installation (published by the National Electrical Contractors Association).
B. NEMA AB1 - Molded Case Circuit Breakers.
C. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.
D. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
E. NEMA PB 1 - Panelboards.
F. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
H. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW
A. Division 01 – Submittals: Procedures for submittals.
B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
C. Arrange circuit breakers in panels same as shown on plans.

1.5 SUBMITTALS FOR INFORMATION
A. Division 01 – Submittals: Submittals for information.
B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 SUBMITTALS FOR CLOSEOUT
A. Division 01 – Project Record and Closeout Documents: Submittals for project closeout.

B. Record actual locations of panelboards and record actual circuiting arrangements in project record documents.

C. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.9 MAINTENANCE MATERIALS

A. Division 01 – Project Record and Closeout Documents.

PART 2 -PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

A. Manufacturers:

1. General Electric.
2. Siemens.
3. Square D.

B. Description: NEMA PB 1, circuit breaker type.

C. Service Conditions:

1. Temperature: 100 degrees F.
2. Altitude: 1000 feet.

D. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208-volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards. Provide higher ratings where indicated. Series rating not allowed.

F. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for heating, air conditioning, or refrigeration equipment branch circuits. Provide circuit breakers UL listed SWD for NO-OFF control of lighting or other loads.

G. Enclosure: NEMA PB 1, Type 1 for dry locations, type 3R for exterior locations.

H. Cabinet Front: Surface type, fastened with hinge and latch, hinged door with flush lock, metal directory frame, finish in manufacturer’s standard gray enamel.
J. Where multiple section panel cabinets are specified, all cabinets shall be of same dimensions.

2.2 LIGHTING AND APPLIANCE PANELBOARDS

A. Manufacturers:
   1. General Electric.
   2. Siemens.
   3. Square D.

B. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.

D. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208-volt panelboards; 14,000 amperes rms symmetrical for 480-volt panelboards. Provide higher ratings where indicated. Series rating not allowed.

E. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for heating, air conditioning, or refrigeration equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

F. Enclosure: NEMA PB 1, Type 1 for dry locations, type 3R for exterior locations.

G. Cabinet Box: 6 inches deep, 20 inches wide. Where multiple section panel cabinets are specified, all cabinets shall be of same dimensions.

H. Cabinet Front: With concealed trim clamps, door in door type hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

I. Where multiple section panel cabinets are specified, all cabinets shall be of same dimensions.

J. Provide handle locks for certain breakers as identified in panel schedules.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1 and the NECA "Standard of Installation."

B. Install panelboards plumb. Install recessed panelboards flush with wall finishes.

C. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor and with handle of top circuit breaker no more than 6'-6" above floor.

D. Provide filler plates for unused spaces in panelboards.

E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads and as-built conditions.
F. Provide screw-on type engraved plastic nameplates under the provisions of Section 16195.

G. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Stub spare conduits out of wall minimum 6" below roof joist in areas with exposed roof structure. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.

H. Ground and bond panelboard enclosure according to Section 16170.

I. Do not splice conductors in panelboard cabinets.

J. Land only one conductor to each circuit breaker. Where multiple conductors are used, splice in junction box before entering panelboard.

K. Where multiple ground terminal strips are provided with new panels, run solid, bare, #8AWG between all ground terminal strips.

L. Provide and install arc flash warning signs per NEC 110.16.

M. Rigidly mount surface mounted panels to unistrut supports spanning a minimum of two studs. Panel shall be supported at a minimum of two locations vertically. Provide similar installation at masonry construction. Toggle bolts shall not be used.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.

3.3 CLEANING

A. Division 01 – Cleaning: Clean installed work.

B. Touch up scratched or marred surfaces to match original finish.

C. Clean dust and debris from interior and exterior of panelboards.

END 16470
PART 1 - GENERAL

1.1 SECTION INCLUDES
   
   A. General purpose contactors.
   
   B. Lighting contactors.

1.2 REFERENCES
   
   A. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
   
   B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
   
   C. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW
   
   A. Division 01 – Submittals: Procedures for submittals.
   
   B. Product Data: Provide dimensions, size, voltage ratings and current ratings.

1.4 SUBMITTALS FOR INFORMATION
   
   A. Division 01 - Submittals: Submittals for information.
   
   B. Submit manufacturer’s installation instructions.

1.5 PROJECT CLOSEOUT SUBMITTALS
   
   A. Division 01 – Phase Turnover and Contract Closeout.
   
   B. Record actual locations of each contactor and indicate circuits controlled on project record documents.
   
   C. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

1.6 QUALIFICATIONS
   
   A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS
   
   A. Conform to requirements of NFPA 70.
   
   B. Provide Products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE CONTACTORS
   
   A. Manufacturers:
      
      1. General Electric.
      
      2. Siemens.
3. Square D.
4. ASCO.
5. Allen-Bradley.
6. Cutler Hammer.

B. Description: NEMA ICS 2, AC general purpose magnetic contactor.

C. Coil Voltage: 277 volts, 60 Hertz or as indicated. Separate latching and unlatching coils with coil clearing contacts in series with each coil to ensure only momentary contact.

D. Poles: As scheduled or indicated.

E. Size: As scheduled or indicated.

F. Enclosure: ANSI/NEMA ICS 6, Type as required to meet conditions of installation.

G. Surface mount in janitor, mechanical and electrical spaces. Surface mount above panels where panel is surface mounted. Flush mount above flush mounted panel or surface mount above accessible ceiling.

H. Label per Section 16195.

2.2 LIGHTING CONTACTORS

A. Manufacturers:
   1. General Electric.
   2. Siemens.
   3. Square D.
   4. Asco.
   5. Allen-Bradley.
   6. Cutler Hammer.

B. Description: NEMA ICS 2, magnetic lighting contactor.

C. Configuration: Mechanically held, 3 wire control.

D. Coils: 120 volts, 60 Hertz. Separate latching and unlatching coils with clearing contacts in series with each coil to ensure only momentary energization of coils.

E. Poles: As scheduled or indicated.

F. Contact Rating: As scheduled or indicated. Match branch circuit overcurrent protection, considering derating for continuous loads.

G. Enclosure: ANSI/NEMA ICS 6, Type as required to meet conditions of installation.

H. Accessories:
   1. Auxiliary Contacts: Two field convertible.

I. Label per Section 16195.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount contactors true and plumb according to manufacturer’s written instructions.

B. Ensure proper operation by several open/close operations of the load contacts.
3.2 CLEANING

A. Division 01 – Cleaning: Cleaning installed work.

B. Touch up scratched or marred surfaces to match original finish.

C. Clean dust and debris from interior and exterior of contactors.

3.3 LABELLING

A. Provide engraved nameplate per 16195. Nameplate shall indicate contactor designation and branch circuits controlled. Example: “CONTACTOR LC-1” on first line; “CKTS HAA 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41” on second line.

END 16485
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Interior luminaires and accessories.
B. Exit signs.
C. LED Drivers.
D. LEDs.
E. Luminaire accessories.

1.2 REFERENCES
B. IES LM-79 – LED lamp and luminaire performance
C. IES LM-85 - LED Package Characteristics.
D. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
E. NFPA 70 - National Electrical Code.
G. UFC 3-350-01 Change 3, 01 June 2016

1.3 SUBMITTALS FOR REVIEW
A. Division 01 – Submittals: Procedures for submittals.
B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer. Provide ballast information for each fixture.
C. Product Data: Provide dimensions, ratings, and performance data.

1.4 SUBMITTALS FOR INFORMATION
A. Division 01 – Submittal: Submittals for information.
B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 SUBMITTALS FOR CLOSEOUT
A. Division 01 – Project Record and Closeout Documents: Submittals for project closeout.
B. Submit manufacturer’s operation and maintenance instructions for each product.
C. Warranty for normal ballasts, exit signs, and emergency standby ballasts.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS
A. Conform to requirements of NFPA 70.
B. Conform to requirements of NFPA 101.
C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 LUMINAIRES
A. Furnish products as scheduled. Contractors wishing to submit voluntary substitutions shall submit complete cut sheet information showing fixture dimensions, options and photometrics. Alternate fixtures must be received at engineers’ office minimum two weeks prior to bidding. Engineer will send approved submittal to base for any additional review comments. Engineers’ and base maintenance shop’s evaluation shall be final. Fixtures submitted without prior approval or outside this time window will be returned to contractor without comment.
B. Luminaires shall meet the following minimum requirements:
   1. Only brand name fixtures shall be used. See fixture schedule
   2. Correlated Color Temperature (CCT):
      a. Interior luminaires shall be nominal 3500K (per LM-79 Test).
   3. Color Rendering Index (CRI):
      a. Interior luminaires: >80, R9>0 (per LM-79 Test).
   4. Luminaire efficacy: >100 Lumens per Watt (LPW).
   5. Reported L90* > 60,000 hours.
   6. Dual rated 120-277V 60 Hz.
   7. Transient Protection: 100kHz ring wave, 2kV level.
   8. Total current harmonic distortion: ≤ 20%.
   9. Power Factor (PF): ≥ 0.9.
   10. Class 2, replaceable, high efficiency LED driver rated for 60,000 hours.
   12. Underwriter Laboratory (UL) listed.
   13. Electrical components shall be assessable from below the ceiling.
   14. Modularly replaceable drivers.

   *Lumen Maintenance at 25 deg C ambient temperature shall be based on calculations per The Illuminating Engineering Society of North America (IESNA) standard, TM-21 and performed by an accredited National Voluntary Laboratory Accreditation Program (NVLAP) laboratory.

C. Warranty:
   1. 10 YEARS

2.2 LED DRIVERS
A. Manufacturers:
   1. Manufacturers Standard complying with ANSI ANSLG requirements.
B. Warranty:
   1. Drivers shall be rated for a minimum operation of 60,000 hours
2.3 LED Standby Drivers

A. Manufacturers: Bodine, ITOA or approved equal.

B. Description: Emergency battery power supply suitable for installation in ballast compartment of fluorescent luminaire or for remote mounting.

C. Ratings: As shown on fixture schedule.

D. Battery: Sealed pure lead type, rated for 10-year life. Provide minimum 3-year full warranty.

E. Include TEST switch and AC ON indicator light, installed to be operable and visible from the outside of an assembled luminaire.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Support recessed luminaires independent of ceiling framing.** For recessed fluorescent luminaires, provide four hanger wires fastened at corners of luminaires and at structural joists. Provide two hanger wires for recessed downlights. Supports wires shall be same type and gauge as ceiling support wires.

B. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

C. Support surface mounted luminaires on grid ceiling directly from building structure.

D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

E. Install recessed luminaires to permit removal from below.

F. Install accessories furnished with each luminaire.

G. Connect luminaires to branch circuit outlets provided under Section 16130 using flexible conduit. In exposed grid ceiling areas, use premanufactured wiring systems at contractor’s option.

H. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

I. Bond products and metal accessories to branch circuit equipment grounding conductor.

J. Install specified lamps in each luminaire.

3.2 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

A. Aim and adjust luminaries as directed.

B. Position exit sign directional arrows as indicated.

3.4 CLEANING
A. Division 01 – Cleaning: Cleaning installed work.
B. Clean electrical parts to remove conductive and deleterious materials.
C. Remove dirt and debris from enclosures.
D. Clean photometric control surfaces as recommended by manufacturer.
E. Clean finishes and touch up damage.

3.5 PROTECTION OF FINISHED WORK

A. Prior to final acceptance, replace luminaires that have failed LEDs.

END 16510
PART 1 - GENERAL

1.1 WORK INCLUDES

A. Contractor provide:
   1. SPD units mounted integral distribution panelboards as indicated on riser diagram.

1.2 RELATED SECTIONS

A. Section 16470 – Panelboards.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. Underwriters Laboratory (UL)
B. American National Standards Institute (ANSI)
C. Institute of Electrical and Electronics Engineers (IEEE)
D. National Electrical Manufacturers Association (NEMA)
E. National Fire Protection Association (NFPA)
F. Occupational Safety and Health Act (OSHA)
G. Federal Information Processing Standards, Pub 94 (FIPS)
H. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits, Category C
J. UL 1449, Current Edition – Surge Protective Devices
K. UL 1283
L. NEMA LS-1, Low Voltage Surge Protective Devices
M. NEC Article 285

1.4 SUBMITTALS

A. In accordance with Division 01, provide:
   1. Shop drawings and product data sheets indication physical and electrical characteristics in accordance with Division 1.
   2. UL1449 file card copies.
   3. Third party test results verifying label ratings.

1.5 WARRANTY

A. Warrant all equipment for ten (10) years from date of substantial completion. This shall include unlimited free parts and labor for replacement of the unit if destroyed by lightning or other transients during the warranty period.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Liebert.
B. Current Technology.
C. EFI Electronics.
D. United Power.
E. Leviton.
F. Square D.
G. Siemens ITE.
H. G.E.

2.2 ELECTRICAL REQUIREMENTS

A. SPD Types

1. Distribution Panel and switchboard: SPD shall be UL 1449 labeled as Type 4 intended for Type 1 or Type 2 applications, verifiable at UL.com, without need for external or supplemental overcurrent controls.
2. Branch Panels: The panelboard shall be UL 67 listed and the SPD shall be UL 1449 labeled as Type 1 or as Type 4 intended for Type 1 or Type 2 applications.

B. Nominal System Operating Voltages

1. 208Y/120 VAC, 3-phase, 4 wire, plus ground for panelboard units.

C. Maximum Continuous Operating Voltages (MCOV)

1. 125% of nominal system operating voltage.

D. Operating Frequency

1. 60 Hertz.

E. Seven (7) Protection Modes on Grounded Wye System

1. L-G, L-N and N-G (L = Line, N = Neutral, and G = Ground).

F. The SPD shall be UL Tested and labeled as a complete assembly to a symmetrical fault current rating greater than or equal to the rating of the connected panel, in accordance with NEC Article 285, without the requirement of a dedicated breaker feeder to obtain the fault current withstand rating.

G. The Voltage Protection Rating (VPR) shall be tested with the integral disconnect in accordance with UL-1449, Third Edition. The UL VPR values shall not exceed the following (including disconnect). If the device is remote mounted it shall be fed by a circuit breaker and the UL VPR rating shall include the breaker in series with the SPD.

H. Maximum UL 1449 Voltage Surge (Category C1)

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>L-N, L-G, N-G Modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120 VAC</td>
<td>800V</td>
</tr>
</tbody>
</table>

SURGE PROTECTION DEVICES (SPD) 16685-2
I. Protection and Filtering Elements:

1. The SPD shall have a maximum surge current rating of:
   Switchboard       100 kA per mode.
   Distribution Panel 100 kA per mode.
   Branch Panel       100 kA per mode.

   Devices that derive a maximum surge current rating by adding test results of individual components are not acceptable. Test documentation of kA rating shall be required. Devices must be rated per mode, not per PHASE per NEMA.

2. The SPD device repetitive surge current capacity shall be tested utilizing a 1.2x50ms, 20kV open circuit voltage, 8x20ms, 10kA short circuit Category C3 test waveform (as defined by ANSI/IEEE C62.41-1991 and ANSI/IEEE C62.45-1992) at one minute intervals. A failure is defined as either performance degradation or more than 10% deviation of clamping voltage at the specified surge current. The service entrance device shall be capable of surviving a minimum of 20,000 C3 impulses without failure or performance degradation of more than 10%. Downstream devices shall be capable of surviving a minimum of 5,000 C3 impulses without failure or performance degradation of more than 10%.

3. The SPD device shall be capable of surviving a minimum of 5,000 surges using a 10x1000ms impulse (1kV, 4kA for 277/480V devices, .5kV, 2kA for 120/208V devices), confirmed by an independent nationally recognized test lab (R&B Labs).

4. Systems using selenium, gas tubes or silicon avalanche diodes in surge current path are not acceptable.

5. The Maximum Continuous Operating Voltage (MCOV) for all voltage configurations shall be 125% of nominal or greater.

6. The fusing system shall be capable of allowing the rated maximum surge current to pass through without fuse operation. Systems utilizing a fusing system that opens below the maximum surge current level are unacceptable. The fusing system shall be included in the surge current testing.

J. The SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of – 50dB at 100kHz.

K. The SPD shall be UL labeled with 20kA I-nominal (I-n).

L. Overcurrent Protection:

1. Fuses rated for 200 KAIC (integral fused disconnect).

M. Diagnostic Monitoring:

1. Fuse monitoring.
2. MOV monitoring.
4. Form C contacts for remote annunciation of unit status.
5. Press-to-test diagnostics to verify operational integrity of monitoring system.
6. Surge event counter and audible alarm.
7. Remote status monitor.

N. Serviceability:

1. SPD system module(s) must be field replaceable by qualified individuals or licensed Electricians.

O. Equipment Mounting:

1. Switchboard & Distribution Panel SPD – The SPD shall include an integral
disconnect switch which has been tested to the surge current rating of the SPD and match or exceed the fault current rating of the board per NEC 285. The Disconnect must switch the phases and neutral. Use of circuit breakers for disconnect mean is not acceptable due to impedance and the requirement for neutral disconnect. The SPD shall be mounted integral to the equipment.

2. Branch panel SPD – the SPD shall be direct bus to bus connected. Use of a breaker to feed an integral device shall not be acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install SPD units per manufacturer's written recommendations.

B. Verify SPD unit ratings with service rating and voltage characteristics, and with Electrical Requirements section of this specification. Ensure proper system configuration and coordination prior to ordering any equipment.

C. Do not drill or tap equipment bus bars. Use suitable bolted bus connectors.

D. Connect separately mounted SPD units to equipment with input conductors that are as short and straight as practically possible. Twist input conductors to reduce inductance.

E. Provide source breaker or fused disconnect switch for SPD units sized in accordance with SPD manufacturer's recommendations.

F. Ground equipment and SPD units per manufacturer's recommendations, NEC, and Section 16170.

G. Provide mounting brackets, bus bar, breaker stabs, and filler pieces for unused spaces.

3.2 FIELD QUALITY CONTROL

A. Perform SPD unit tests according to manufacturer's instructions. Provide verification of test results to Architect/Engineer.

B. Provide services of manufacturer's factory trained Engineer for length of time required to:

   1. Coordinate installation.
   2. Conduct functional tests on all equipment and field test listed herein.
   3. Provide training during normal working hours to AAFES's personnel in operation, testing, adjusting, and maintenance.
   4. Submit written report to Architect/Engineer and AAFES stating results of tests conducted and listing personnel trained.

3.3 ADJUSTMENT AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Tighten bus connections and mechanical fasteners, in accordance with manufacturer's published torque value recommendations and UL 486A and B.

C. Touch-up scratched or marred surfaces to match original finish.

D. Clean interior and exterior of enclosure.

END 16685
PART 1 - GENERAL

1.1 WORK INCLUDES

A. Extend and rework existing lightning protection system as required for demolition and new roof mounted equipment at the existing facility.

B. Coordinate the work with other trades.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract Documents, including General and Supplementary Conditions apply to this Section.

1.3 SUMMARY

A. Section includes lightning protection for structures.

1.4 SUBMITTALS

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

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.

2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

C. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL

D. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

E. Field quality-control reports.

F. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

G. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Bonding connections.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Certified by LPI as a Master Installer/Designer, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.

2. UL Master Label Recertification
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, Class I copper unless otherwise indicated.

1. Materials: Subject to compliance with requirements, provide products similar to existing conditions.

2. Subject to compliance with requirements, provide products by one of the following:
   a. East Coast Lightning Equipment Inc.
   b. ERICO International Corporation.
   c. Harger.
   d. Heary Bros. Lightning Protection Co. Inc.
   e. Independent Protection Co.
   f. Preferred Lightning Protection.
   g. Robbins Lightning, Inc.
   h. Thompson Lightning Protection, Inc.

C. Main and Bonding Conductors: AL.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors.

2. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.

D. Cable Connections: Use crimped or bolted connections for all above-ground conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

E. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.
3.2 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL

A. Notify AAFES contracting officer’s representative at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Equipment and terminal backboards
B. Premises wiring and outlets.

1.2 REFERENCES
A. EIA/TIA 568B - Commercial Building Wiring Standard.
B. EIA/TIA 569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
C. Network Enterprise Center (NEC). Communications Squadron Standards.

1.3 SYSTEM DESCRIPTION
A. Premises Wiring: AAFES furnished / AAFES installed.
B. Accessories: AAFES furnished / AAFES installed.
C. Grounding: Contractor Furnished / Contractor Installed.
F. The telephone system equipment is AAFES furnished / AAFES installed.

1.4 SUBMITTALS
A. Submit under provisions of Division 01 – Submittals.
B. Product data for cables, outlets, and accessories.

1.5 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Division 01 – Project Record and Closeout Documents.
B. Record actual locations and sizes of raceways and outlets.

1.6 QUALITY ASSURANCE
A. Perform Work in accordance with EIT/TIA, DOIM and commercial telephone utility’s rules and regulations.

1.7 REGULATORY REQUIREMENTS
A. Conform to requirements of NFPA 70.
B. Furnish Products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 TELEPHONE TERMINATION BACKBOARDS
A. Material: Plywood.
B. Size: As indicated, 3/4 inch thick. Coordinate with Base fire department when area of any back board exceeds 32 sq. ft.

C. The telephone back board shall be painted with two coats of fire retardant paint to match the surrounding walls.

2.2 TELEPHONE CABLES – AAFES FURNISHED / AAFES INSTALLED

2.3 JACKS – AAFES FURNISHED / AAFES INSTALLED

2.4 PATCH PANELS – AAFES FURNISHED / AAFES INSTALLED

2.5 GROUNDING

A. Provide a single point ground for communications electronic equipment. Ground shall be by a copper ground plate width x length of terminal board. Install ground plate along bottom edge of terminal board. Connect ground riser with #1 AWG directly connected to ground plate with no taps. Resistance shall be 10 ohms or less measured from main ground point.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Stub minimum ¾” conduit (or larger where indicated) from each outlet location to 12” above accessible ceiling. Provide bushing at end of conduit.

B. Provide wire and cable in accordance with manufacturer’s instructions and in accordance with EIA/TIA 568.

C. Finish paint termination backboards with durable white enamel under the provisions of Section 09900 prior to installation of telephone equipment.

D. Support raceways, backboards, and cabinets under the provisions of Section 16190.

E. Install termination backboards plumb and attach securely to building wall at each corner.

END 16741
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Coordination of AAFES furnished / AAFES installed equipment:

1.2 REFERENCES

A. NFPA 70 - National Electrical Code.

PART 2 - PRODUCTS

2.1 AAFES FURNISHED/AAFES INSTALLED EQUIPMENT

A. Amplifiers:
B. Interface Modules:
C. Rack Mounting Hardware:
D. Speakers:
E. Speaker Cables

2.2 EXECUTION

A. Contractor shall coordinate with AAFES PA equipment installer to ensure coordination with construction schedule. Notify A/E of any coordination issues that arise from these conversations.

B. Contractor shall take down and turn over existing PA speakers to Store Manager at existing Main Store MPA.

C. New PA speaker installation, wiring and final connections shall be AAFES Furnished / AAFES Installed.

END 16770
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Occupancy sensors for lighting control.

1.2 RELATED SECTIONS
A. Section 16111 - Conduit.
B. Section 16123 - Building Wire and Cable.
C. Section 16130 - Boxes.

1.3 REFERENCES
A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS
A. In accordance with Division 01 – Submittals, provide:
   1. Product Data: Provide electrical ratings, adjustment ranges, enclosure type, outline dimensions, mounting dimensions, and terminal connection information.
   2. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS
A. Conform to requirements of NFPA 70.
B. Provide Products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 SENSORS
A. Ceiling mounted dual technology sensors shall employ both passive infrared and ultrasonic detection methods. Sensors shall have a multiple segmented lens and provide coverage for up to a 40' x 40' room.
B. Wall Mounted combination dual technology sensors with integral light switch shall employ both passive infrared and ultrasonic detection methods. Sensors shall have a multiple segmented lens and provide coverage for the room being served. Unit shall have integral on / off switch.
C. All sensors shall be capable of operating normally with any electronic ballasts and compact fluorescent lamp systems.
D. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
E. All sensors shall have readily accessible, user adjustable controls for time delay (0 - 15 minutes) and sensitivity.

F. In the event of failure, a bypass manual “override on” shall be provided on each sensor. When bypass is utilized, control shall divert to a wall switch until sensor is replaced.

G. All sensors shall provide a method of indication to verify that motion is being detected during testing and that the unit is working.

H. All sensors shall have no leakage current to load, in manual or in Auto/Off mode, for safety purposes and shall have voltage drop protection.

2.2 CIRCUIT CONTROL HARDWARE - CU

A. Control unit(s) shall mount through a 2” knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Transformer shall provide power to a maximum of four (4) sensors and shall power to a larger number of sensors where indicated on plans.

B. Relay contacts shall have ratings of:
   1. 20A - 277 VAC Ballast.
   2. Where noted on plans, provide relays with two (2) load contacts.

C. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded UL Classified, jacketed cable. Cable shall be plenum rated.

2.3 MANUFACTURERS

A. Leviton.

B. Wattstopper.

C. Hubble.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and aim sensors in the correct location required for complete coverage. Rooms shall have ninety (90) to one hundred (100) percent coverage. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. Provide additional sensors if required to properly and completely cover the respective room.

B. Meet with the manufacturer’s factory authorized representative, at the jobsite, to verify placement of sensors and installation criteria prior to beginning work.

C. Locate sensors to ensure the best possible coverage in the available space and to overcome local difficulties due to space limitations or interference of structural components. Provide training necessary to familiarize Owner’s key personnel with the operation, use, adjustment, and problem-solving diagnosis of the occupancy sensing devices and systems.

END 16904
PART 1 - GENERAL

1.1 WORK INCLUDES

A. Provide:

1. Testing of electrical components and systems:
   a. Insulation resistance test.
   b. Grounding electrode test.
   c. Continuity test.
   d. Voltage test.
   e. Phase relationship verification.

2. Test reports.
3. Correction of defective components or systems.
4. Retest of corrected components, systems.

1.2 SUBMITTALS

A. Test Reports: Submit seven (7) copies of all test reports to Contracting Officer.

1. Type each test report on 8-1/2” x 11” paper. Include:
   a. Project Number.
   b. Project title and location.
   c. Test performed.
   d. Date performed.
   e. Test equipment used.
   f. Contractor's name, address and telephone number.
   g. Testing firm's name, address and telephone number if other than Contractor.
   h. Name (s) and title (s) of person (s):
      1. Performing test.
      2. Observing test.
   i. Statement verifying each test.
   j. Nameplate data from each motor and equipment item tested.
   k. Test results.
   l. Retest results after correction of defective components, systems.

2. For each copy, assemble all test reports and bind them in a folder. Label each folder, "Electrical Test Reports".

PART 2 - PRODUCTS

2.1 MATERIALS: Furnish all equipment, manpower and casual labor to perform specified testing.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ensure that all electrical work is complete and ready for testing.

B. Disconnect all devices or equipment that might be damaged by application of test voltages, voltage of reversed phase sequence or other test procedures.

3.2 TESTING: Conduct tests and adjust equipment to verify compliance with specified performance.

3.3 INSULATION RESISTANCE TESTS
A. Resistance measured; line-to-ground.

B. Perform testing on the following items:

<table>
<thead>
<tr>
<th>Item Tested</th>
<th>Voltage of Test</th>
<th>Resistance in Megohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No. 2 and larger cables (600V)</td>
<td>1000V</td>
<td>50</td>
</tr>
<tr>
<td>2. Motors</td>
<td>500V</td>
<td>5</td>
</tr>
<tr>
<td>3. Switchboard and Panelboard Buses</td>
<td>1000V</td>
<td>25</td>
</tr>
</tbody>
</table>

3.4 GROUNDING ELECTRODE TEST: Measure and record ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Maximum acceptable resistance: 10 ohms. When resistance exceeds 10 ohms drive and bond another ground rod, one ground rod length away and repeat test.

3.5 CONTINUITY TESTS: Test branch circuits and control circuits to determine continuity of wiring and connections.

3.6 VOLTAGE TESTS

A. Make and record voltage tests and recorded at the following listed points. Conduct tests under normal load conditions.

1. Service entrance at main panel.
2. Terminals of all motors.
3. Lugs of each new panel
4. Load and line side terminals of new transformers.

3.7 PHASE RELATIONSHIP

A. Examine connections to equipment for proper phase relationships. Verify proper motor rotation.

3.8 CORRECTION OF DEFECTS

A. When tests disclose any unsatisfactory workmanship or equipment furnished under this Contract, correct defects and retest. Repeat tests until satisfactory results are obtained.

B. When any wiring or equipment is damaged by tests, repair or replace such wiring or equipment. Test repaired items to ensure satisfactory operation.

END 16950